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GOVERNMENT
PUBLICATIONS

DEPARTMENT OF INTERIOR OF CANADA

Hon. W. J. ROCHE, Minister; W. W. CORY, Deputy Minister

Irrigation Branch—E. F. DRAKE, Superintendent

REPORT ON
IRRIGATION SURVEYS
AND INSPECTIONS

1915-16

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GOVERNMENT
PUBLICATION

OTTAWA
GOVERNMENT PRINTING BUREAU

1916

DEPARTMENT OF THE INTERIOR, CANADA
IRRIGATION BRANCH

ROLL OF HONOUR

Employees Enlisted for Active Service

J. W. H. Wilkes	Leveller	Aug. 16, 1914	Pte. Royal Dragoons
E. S. McMillan	Draughtsman	Aug. 21, 1914	Spr. Div'l Engineers
W. E. Dow	Draughtsman	Aug. 22, 1914	Q.M.S. Div'l Cyclists
C. V. Craik	Asst. Engineer	Aug. 22, 1914	Corp. Div'l Engineers
E. S. Clifford	Hydro. Asst.	Aug. 24, 1914	Maj., Asst. Provost Marshal
R. V. Muller	Leveller	Aug. 26, 1914	Pte. Royal Dragoons
C. E. Vrooman	Leveller	Sept. 26, 1914	Spr. Div'l Engineers
C. P. Maxted	Rodman	Sept. 26, 1914	Spr. Div'l Engineers
H. E. Bowden	Teamster	Sept. 26, 1914	Spr. Div'l Engineers
J. S. Ferrier	Draughtsman	Nov. 6, 1914	Lieut. Northumberland Fus.
H. D. St. A. Smith	Asst. Engineer	Nov. 9, 1914	Lieut. Div'l Engineers
C. B. Hornby	Accountant	Nov. 16, 1914	Lieut. 31st Battalion
G. N. Page	Leveller	Nov. 16, 1914	Pte. Army Service Corps
D. C. McDougall	Accountant	Nov. 19, 1914	Q.M.S. Div'l Engineers
G. H. Nettleton	Hydro. Asst.	Jan. 4, 1915	Sergt. 12th Mounted Rifles
H. S. Kerby	Engineer	Feb. 11, 1915	Lieut. Royal Aviation Corps
J. H. Jones	Asst. Engineer	April 26, 1915	Capt. 56th Battalion
E. W. W. Hughes	Engineer	May 8, 1915	Pte. 53rd Battalion
G. R. Elliott	Engineer	Aug. 16, 1915	Lieut. Div'l Cyclists
W. T. White	Asst. Engineer	Aug. 16, 1915	Lieut. 1st Pioneer Battalion
H. W. Cheney	Asst. Engineer	Sept. 29, 1915	Lieut. 4th University Co.
W. E. Hunter	Accountant	Oct. 2, 1915	Sergt.-Maj. 77th Battalion
E. L. Hornby	Draughtsman	Oct. 12, 1915	Pte. 1st Pioneer Battalion
J. Cawthorn	Clerk	Oct. 14, 1915	Pte. 1st Pioneer Battalion
H. B. R. Thompson	Engineer	Nov. 8, 1915	Pte. 1st Pioneer Battalion
F. R. Burfield	Engineer	Dec. 31, 1915	Corp. 2nd Tunnelling Co.
W. G. Guthrie	Draughtsman	Feb. 20, 1916	Pte. Army Medical Corps
L. E. M. Shenton	Draughtsman	Feb. 24, 1916	Spr. Australian Imp. Forces
W. B. Hutcheson	Asst. Engineer	Mar. 13, 1916	Lieut. Div'l Engineers
H. R. Carscallen	Engineer	Mar. 31, 1916	Lieut. Div'l Engineers
W. R. McCaffrey	Engineer	Mar. 31, 1916	Sergt. 4th Div'l Cyclists
R. E. Matheson	Hydro. Asst.	Mar. 31, 1916	Spr. Div'l Engineers
P. J. Jennings	Engineer	April 1, 1916	Capt. & Adj. 4th Pioneer Batt.
G. H. Whyte	Engineer	April 4, 1916	Lieut. Div'l Engineers
T. H. Burt	Hydro. Asst.	April 4, 1916	Pte. Army Medical Corps
R. H. Goodchild	Engineer	April 22, 1916	Lieut. 4th Pioneer Battalion
L. J. Gleeson	Asst. Engineer	May 9, 1916	Gunr. 50th Queen's Battery
F. K. Beach	Engineer	May 21, 1916	Lieut. 211th Battalion
J. M. Paul	Engineer	May 22, 1916	Gunr. 50th Queen's Battery
O. H. Hoover	Engineer	June 15, 1916	Pte. Tor. Univ. Battalion
I. R. Strome	Engineer	June 20, 1916	Lieut. 192nd Battalion
J. A. Currie	Draughtsman	Aug. 1, 1916	Gunr. 73rd Field Battery

DEPARTMENT OF THE INTERIOR OF CANADA

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GOVERNMENT PRINTING BUREAU
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IRRIGATION SURVEYS AND INSPECTIONS

REPORT OF THE SUPERINTENDENT OF IRRIGATION.

OTTAWA, June 7, 1916.

W. W. CORY, Esq., C.M.G.,
Deputy Minister of the Interior,
Ottawa, Ont.

SIR,—I have the honour to submit herewith the report of the Irrigation Branch for the year ended March 31, 1916, comprising brief reports by myself and by F. H. Peters, C.E., Commissioner of Irrigation and Chief Engineer, under whose immediate supervision most of the work was conducted.

My own report is merely a general review of the work of the year, with some discussion of the development of irrigation farming and of a few of the more important phases of the work of the branch, while Mr. Peters has briefly summarized the several features of the work; it is understood that separate reports will be published covering the more important surveys and inspections made during the year, and that the stream measurement data will be published as heretofore.

The grain crop of the Prairie Provinces for 1915 was the most bountiful so far recorded, and the yield was particularly heavy in southern Alberta and southwestern Saskatchewan where, in 1914, the severe drought caused an almost complete crop failure. It is not too much to say that last year's crop in these districts was the equivalent of two, and in some instances three, average crops. Yields of 50 bushels of wheat per acre were common, and 60 and even 70 bushels per acre were by no means rare. Summer-fallowed land as usual produced the best crops, but even the haphazard and slovenly farming methods which are unfortunately too common produced results that in an ordinary year would have been considered remarkable.

As usual, this bountiful harvest has already brought prominently to the front those who assert that irrigation in these districts is not required. The evidence seemingly tends in exactly the opposite direction. The soil is unquestionably fertile, but, even with rich soil and long, sunshiny days, there was an almost complete crop failure over a wide extent of country in 1914, while the same soil in 1915, with about eight inches more rainfall distributed throughout the growing season, gave a bountiful harvest. It may be, and doubtless is, true that good grain crops can be produced in these districts in most years without irrigation, if modern farming methods are carefully followed. But the record of past years points to the periodical recurrence of dry years with complete or partial crop failure, and continuous grain farming under such conditions is the least profitable form of agriculture; it inevitably results in soil impoverishment, and can therefore be looked upon only as a temporary expedient. As compared with mixed farming, where practicable, grain farming (or grain mining) has little to commend it. And mixed farming in the dry belt is possible only when irrigation water is available for the raising of forage crops for the feeding of live stock.

Mixed farming, or rather the growing of diversified crops in combination with live stock, preserves soil fertility, is profitable and interesting, and tends towards the building up of permanent farm homes and creating in the farm boys and girls an interest and pride in their homes and occupations which they entirely miss on a grain farm. The permanent settlement and prosperity of the dry belt is largely dependent upon the fullest possible development of irrigation, and therefore engineers of the Irrigation Branch have, during the past few years, devoted most of their time and

energy towards the investigation of all possible sources of water supply and the survey and location of canal systems to fully utilize such supply to the best possible advantage. It is unfortunately true that the area of land requiring irrigation far exceeds the available water supply, but the feasible irrigation projects are so situated that there is possible a combination of irrigated and dry farming that will eventually reclaim and render profitable a very considerable proportion of the dry belt where ordinary farming methods have heretofore been far from successful.

THE DEVELOPMENT OF IRRIGATED FARMING IN CANADA.

Irrigated farming was begun on a small scale in southern Alberta about twenty-five years ago in connection with the cattle industry. The earliest attempts were somewhat crude, and consisted chiefly in the wild flooding of natural hay meadows and in the growing of garden truck. The enactment of the first Canadian irrigation law in 1894 gave irrigation its first impetus, and this was largely due to the personal influence and effort of Mr. J. S. Dennis who, as the first Commissioner of Irrigation, administered the law during the first eight years after its enactment. During this period the principal development took place in the foot-hills country around and south of Calgary, and it is rather curious to note that in more recent years a great many of these earlier projects have been abandoned.

In some cases abandonment has been due to insufficient water supply. No records of stream flow were available in those early days, and there was insufficient knowledge of the quantity of water required to properly irrigate a given area of land. The result was that while usually there was ample water for domestic and stock purposes there was seldom enough for irrigation in dry years, and that was the only time irrigation was necessary.

Another, and perhaps the chief, cause of abandonment was the occurrence of several unusually wet years, beginning with 1897, which, following a long succession of dry years, led many to believe that the climate was changing for the better as a result of settlement and development. This belief persisted until about 1910, and during this period many promising irrigation projects were abandoned. But the severe drought of 1910, followed by the still more adverse conditions of 1914, have probably convinced most of the settlers that man's puny efforts in the way of settlement and cultivation of the soil, while making possible a fuller utilization of the rainfall, have little or no effect on its volume or seasonal occurrence.

During the first few years after the passing of the Irrigation Act in 1894, surveys were made under the direction of Mr. Dennis to determine the feasibility of utilizing the waters of some of the larger streams in southern Alberta for the irrigation of large tracts of land which were seemingly well adapted for that purpose but which up to that time had been used only for grazing. Three such projects were located and surveyed in sufficient detail to demonstrate their entire feasibility. It is interesting to note that two of these projects have since been constructed and are now in more or less successful operation, while the third is now under construction, and that in each instance the development of the project followed very closely the lines of the original surveys.

THE ALBERTA RAILWAY AND IRRIGATION COMPANY'S PROJECT.

The first of these projects to be developed was that of the Alberta Irrigation Company, subsequently known as the Canadian Northwest Irrigation Company, and later as the Alberta Railway and Irrigation Company, now controlled by the Canadian Pacific Railway Company and operated as the "Lethbridge section" of that company's several irrigation projects.

Authority for the construction of works was granted in 1899, and in 1900 separate authorization was issued for the construction of works for the utilization of water from several distinct sources of supply. These applications were subsequently merged

and in October, 1902, a further or consolidated and amplified authorization was issued for the construction of a system of works designed to utilize water from St. Mary and Milk rivers and several of their tributary streams, for the irrigation of the irrigable portion of a tract comprising some 500,000 acres of land in the district surrounding and south of Lethbridge, Alta. A period of fifteen years from the 23rd October, 1902, was granted for the construction of the necessary works.

Actual construction work was begun in 1899, and by the end of the year 1900 water from St. Mary river was delivered at Lethbridge. Subsequent development proceeded as rapidly as the settlement of the district warranted, and to-day, although the period allowed for the completion of the works has not expired, the main canal system is practically completed and a considerable proportion of it has been in successful operation for about fifteen years.

The works as they stand to-day consist of 200 miles of main and secondary canals, not including farm laterals, the capacity of the main canal being over 1,000 second-feet. The system has cost \$1,368,000. There are approximately 130,000 acres of land irrigable from the present works, and some 75,000 acres have actually been irrigated. The number of water users is at present 635. The annual water rental, or maintenance charge, is equivalent to \$1 per irrigable acre. The present system of works is susceptible of considerable expansion, but further development is dependent to some extent upon the availability of the necessary water supply, the main sources of supply being international streams and subject to a treaty between Canada and the United States providing for their joint use for irrigation and power by the respective countries. The division of the water under treaty provisions is to be made under the direction of the International Joint Commission, consisting of six members, three for each country. At a meeting held at St. Paul, Minnesota, in May, 1915, the commission heard the evidence in the case but has not yet handed out its decision.

WESTERN SECTION, CANADIAN PACIFIC RAILWAY COMPANY'S IRRIGATION PROJECT.

The second of the large projects investigated by government engineers demonstrated the feasibility of utilizing water from Bow river for the irrigation of a large tract of land extending eastward from Calgary, Alta., along the main line of the Canadian Pacific railway.

The charter of the Canadian Pacific Railway Company entitled it to a grant of 25,000,000 acres of land, to be selected in alternate sections within a belt 24 miles on either side of its line of railway. The company had a right to reject any land not fairly fit for settlement, and had refused to accept as part of its grant any land between Moosejaw and the Rocky mountains. Selections in lieu of the land so rejected were made elsewhere, but at the time of final settlement there was a balance of about 3,000,000 acres due to the company, and it agreed to take the land comprised in this proposed irrigation project, provided it was allowed to take it en bloc. The selection being approved and the lands transferred, the company made further surveys to verify and complete the work previously done by government engineers, and also applied for permission to construct a system of irrigation works and for a water right.

The land selected by the company comprises about 3,000,000 acres in an irregular block of about 125 miles east and west by some 50 miles north and south.

Authority for the construction of the works was issued on the 21st April, 1904, and a period of fifteen years was granted for the completion of the work. For convenience of administration the company divided this large block of land into three sections, known as the western, central and eastern sections, of approximately equal area.

The western section was developed first. Water is taken from Bow river within the limits of the city of Calgary and carried to and through a tract comprising some 600,000 acres, of which about 223,000 acres are irrigable. The westerly limit of the

irrigable land is about 10 miles east of Calgary, and the easterly limit is approximately 45 miles farther east. The works comprise a diversion weir and headgates at Calgary, a main canal 16 miles in length with a capacity of 2,260 second-feet, and secondary canals and laterals with a total length of 2,484 miles. The total cost of the constructed works has been \$4,287,000. The number of water users is 1,738. The annual water rental, or maintenance charge, is 50 cents per irrigable acre.

The works have been in partial use since 1908, but development has been retarded by serious difficulties between the company and some of the water users; these have now been satisfactorily adjusted and the further settlement and development of the district should be rapid.

CENTRAL SECTION.

It was originally the company's intention to irrigate this section by extensions of the canal system which serves the western section. This district is, however, because of its topography, somewhat less well adapted to irrigation than either of the other sections, and its development has been postponed to a later date.

EASTERN SECTION.

Water for the eastern section is taken from Bow river at a point known as the "Horseshoe Bend," about three miles south of Bassano, Alta. The works consist of a concrete spillway dam of the Ambursen type, 720 feet long, to which is joined an earthen embankment 7,180 feet long, by which the level of the river is raised 50 feet. Water is diverted through five steel sluice-gates into the main canal and thence by an elaborate system of canals, reservoirs, flumes, etc., is distributed throughout the tract to be irrigated.

The works consist, in addition to the dam and intake, of 2,500 miles of canals and ditches and a reservoir with a storage capacity of 186,000 acre-feet. There are about 400,000 acres of irrigable land, of which approximately 8,000 acres have so far been irrigated. The number of water users is 67. The cost of the works has been \$9,440,000.

The annual water rental, or maintenance charge, is \$1.25 per irrigable acre, but the water contracts provide for a reduction to 75 cents per acre in the event of the water users forming associations and taking over the maintenance of the works and the distribution of the water within their own districts, in which case the company's responsibility will be limited to the maintenance of the main canal systems and the delivery of water at the upper end of each water district. No such associations have yet been formed, as this section has only recently been opened for settlement and, in fact, no water rental has yet been charged although two or three small colonies of settlers have been supplied with water for two years.

The works in this section are of the most modern type and practically all the structures are of reinforced concrete. The land is well adapted to irrigated farming, and it is expected that the district will eventually be one of the most thickly settled and prosperous in the province. Immediate development, however, will probably be retarded by conditions arising from the war.

SOUTHERN ALBERTA LAND COMPANY.

The third of the projects previously referred to as having been developed by government engineers, takes water from Bow river just south of Carseland at a point about 30 miles southeast of Calgary. Water is taken from the river by means of a diversion weir and headgates through a main canal about 44 miles in length to a

reservoir known as "Lake McGregor" which is capable of storing 300,000 acre-feet of water. The water is then taken from the south end of the reservoir for a distance of 47 miles to the westerly limit of the tract to be irrigated and thence distributed throughout the tract.

The constructed works, other than the dam and reservoir previously referred to, consist of some 300 miles of canals and a smaller reservoir with a capacity of 30,000 acre-feet, several flumes and two wood stave syphons, one of which (not completed) carries the water across Bow river to the easterly portion of the tract to be irrigated. The works so far constructed have cost a little over \$5,000,000. No land has yet been irrigated.

The tract to be irrigated comprises some 442,000 acres, including 380,000 acres purchased from the Crown subject to irrigation conditions. The irrigable area is approximately 153,000 acres. The works are not yet completed, and further construction work has been temporarily abandoned owing to financial difficulties due, in part at least, to conditions arising from the war. The company is making every possible effort to raise additional funds in order to complete the works to a point that will permit of the actual irrigation and development of the most westerly unit of the tract, comprising approximately 21,000 acres of irrigable land. If funds for this purpose can be obtained, it is the company's intention to develop this westerly unit and put it on the market, and to defer the completion of the remainder of the canal system and the development and sale of the remainder of the irrigable land until the first unit shall have been sold and settled.

CYPRESS HILLS DISTRICT.

Following the earlier development of small irrigation projects in the foot-hills region of southern Alberta, the next important development occurred in the Cypress Hills district of southwestern Saskatchewan and southeastern Alberta, beginning about 1908 and continuing for three or four years. This region had from its earliest settlement been devoted almost exclusively to cattle raising, to which it was admirably adapted because of the numerous small streams flowing from the hills and the shelter afforded by the deep valleys and coulees. The transition from range to farm was in no respect different from the changes which have taken place elsewhere in the West as settlement advanced. The earlier farmers, or those of the cattlemen who turned to farming as an adjunct to cattle raising, found irrigation necessary for the growing of winter forage for their stock, and gradually extended their farming operations as advancing settlement encroached upon the free range.

Settlement usually followed the stream valleys, and the diversion of water for the irrigation of the stream bottoms was easy and comparatively inexpensive. Unfortunately, in a good many cases more attention seems to have been given to the purchase of land under the irrigation system and the filing of applications for water rights than to the early construction of works, and in many cases the works actually constructed were not of the most suitable and durable type. This slow and to some extent unsatisfactory development is partly due to the unfavourable conditions beyond the control of the settlers. The life of a pioneer prairie farmer is not altogether a bed of roses. The building of a home, the breaking and fencing of the land, the purchase of farm machinery and stock, and the maintenance of a family until crop returns begin to come in, keep the average man so fully occupied that he has little time and less money to devote to the construction of irrigation works, even though he may clearly enough realize that such works will eventually prove to be his most profitable investment. This is simply an illustration of the fact that a poor man is seldom able to utilize his natural advantages as fully and satisfactorily as his more fortunate neighbour who has some spare cash. And the average pioneer farmer seldom has money enough, and usually has to pay ruinous interest if he is fortunate enough to be able to borrow.

Notwithstanding these disadvantages, material progress, although not very rapid, is being made in irrigation development in this district. There are some ninety-three irrigation projects in this district, comprising some 28,000 acres, but by no means all of this area has as yet actually been irrigated.

Careful investigation by engineers of the Irrigation Branch indicates that there are about 40,000 additional acres susceptible of irrigation on the southern slopes of the Cypress hills in the valleys of Lodge and Battle creeks, and the Frenchman river. No reliable estimate has as yet been made of the area susceptible of reclamation on the northern slopes, as the streams there are smaller and reservoiring facilities less promising.

Several excellent reservoir sites have been located and partially surveyed on the southern slopes of the hills. These are believed to be sufficient to conserve most of the flood waters of Lodge, Battle, and Middle creeks, and the Frenchman river, and their numerous upper tributaries, and to render possible the irrigation of most of the 40,000 acres to which reference has previously been made. The cost of constructing these reservoirs is, however, prohibitive in so far as the settlers themselves are concerned, although quite reasonable in comparison with the resultant advantages, and there is little prospect of their being constructed for some time to come unless with government assistance, which under existing conditions is improbable.

The region between the Cypress hills and the international boundary has developed very slowly, chiefly because of the absence of railways, the nearest railway being, until very recently, the main line of the Canadian Pacific, which is approximately from 60 to 90 miles north of the boundary and some 40 miles north of the crest of the hills. The district south of the hills—a strip some forty or more miles in width, north and south—has been without railway facilities until very recently, but the Weyburn-Lethbridge branch of the Canadian Pacific is now in operation from Weyburn to Altawam and from Foremost to Lethbridge, thus traversing the entire district with the exception of a gap of some 60 miles, between Altawam and Foremost. The completion of this railway, giving convenient access to markets, has already given a considerable impetus to settlement and, with the construction of the reservoirs previously referred to and the completion and full operation of the existing irrigation projects, the district should become prosperous.

DOMESTIC, MUNICIPAL AND INDUSTRIAL WATER SUPPLIES.

The rapid settlement of the Prairie Provinces, the growth of the numerous towns and cities, and the building and operation of the many branch lines of railway, in addition to the three great transcontinental lines, have made the securing of sufficient and suitable water supply an increasingly difficult problem. In the southern portion of the provinces of Alberta and Saskatchewan the problem is, in some districts, exceedingly critical, and the time is not far distant when large expenditures will be required by some of the larger cities and towns, and by the railway companies, for the conveyance of water for long distances to serve the needs of the drier districts.

The situation at Moosejaw, Sask. may be cited as an illustration. When the present city was but a village it secured its domestic water supply from Moosejaw creek which flows past, or through, it. With the growth of the village this supply, never satisfactory in quality, proved unreliable in quantity as well. The creek carries a considerable volume of water in times of flood—in fact destructive floods are not infrequent—but in midsummer and early fall it usually dwindles to insignificance. The creek was finally abandoned as a source of domestic supply, although still retained as an emergency supply for fire protection, and a considerable sum was expended in the development of a supply from Snowy's springs several miles distant. This in turn soon proved insufficient for the needs of the rapidly growing city, and a further supply was developed from Sandy creek, near Caron, some 16 miles west of the city.

The permanence of the present supply is doubtful, and if the city continues to grow as rapidly as within the past few years it will soon become necessary to seek other sources of supply.

Engineers employed by the city have already made preliminary investigations covering possible sources of supply, and have reported that the best available source is the South Saskatchewan river. Engineers of this branch have made surveys for the purpose of determining the most satisfactory and economical method of developing a water supply from this stream, and their conclusions have been published in the reports of this branch for the years 1912, 1913, and 1914. It is probable that no actual construction will be undertaken for some time to come, as the cities of Regina and Moosejaw, both of which and the interlying district can be included in the projected system, have recently expended considerable sums in the enlargement of their present water supply systems, and probably will not take up the larger project until their present supply shows signs of failing to serve their growing needs.

SUMMARY of Irrigation Development.

Large Projects—	Acres.	Acres.
Alberta Railway and Irrigation Company (in operation) ..	130,000	
C. P. R. Western section (in operation)	223,000	
C. P. R. Eastern section (in operation)	400,000	
Southern Alberta Land Company (under construction) ..	153,000	
Alberta Land Company (under construction)	48,850	
		954,850
Smaller Projects—	Acres.	Acres.
269 licensed schemes, comprising	78,401	
74 authorized schemes, comprising	28,644	
2 applications, comprising	73	
39 applications for which no area is yet available ..	....
		107,118
384		
Total		1,061,968

Domestic, Municipal and Other Projects:

69 licensed
46 authorized
144 applications
—
259

Industrial Projects (chiefly railway water supplies):

201 licensed
63 authorized
39 applications
—
303

There are 951 irrigation and water supply projects either completed and licensed, under construction, or waiting authorization.

RECLASSIFICATION OF LAND ON C. P. R. IRRIGATION PROJECT.

In my reports for the past two years reference was made to disagreement between certain settlers and the Canadian Pacific Railway Company as to the area of irrigable land in the western section of that company's irrigation project, and the necessity for this branch to undertake the reclassification of the land. This work was begun in June, 1913, but, owing to the extent of detail involved and the necessity for extreme care in considering each individual case in all its bearings, the field and office work was

not completed until the end of 1915. The net result has been to reduce the irrigable area by about 30 per cent, and it is satisfactory to note that the decision in almost every case, involving the revision of about 1,600 water agreements, has apparently proved acceptable both to the company and to the water users. About 350 revised agreements have actually been filed with the department, and it is understood that the remainder will be completed in due course.

The field work included the detailed examination and survey of about 454,700 acres, of which about 223,500 acres (or 49 per cent) have been classified as irrigable, the remainder being reported as non-irrigable, as follows:—

	Per cent.
On account of topographic conditions.. . . .	35.4
On account of soil conditions.. . . .	13.6
On account of right of way for canals, roads, etc.. . . .	2.0
Total.. . . .	51.0

On the 2nd February, 1915, a temporary permit was issued to the company to divert water from Bow river, and the question of granting a permanent license, based on the reclassification and the extent of the constructed works, is now under consideration.

It was decided in June, 1913, and the company was so advised, that the issue of a water license in its favour for the works in the western section would be deferred until:

1. The reclassification of irrigable land shall have been completed by government engineers;
2. Until the company shall have completed the construction of a weir in Bow river at the point of intake of the main canal; and
3. That the company will be required to make such alterations in its works as may be found necessary and recommended by the Commissioner of Irrigation upon inspection at the conclusion of the work of reclassifying the irrigable land.

The intake weir has been completed, as well as the reclassification of the irrigable land, and certain improvements to secondary canals A and B have been suggested at relatively small cost. It is not considered reasonable, however, to insist upon the immediate undertaking of further alterations to the works unless they can be shown to be absolutely necessary at the present time, and our engineers are now engaged in a detailed inspection of the canals and structures in order that the department may be fully informed of their capacity and condition before completing the arrangements for the issue of a final water license.

Mr. Gavin N. Houston, C.E., has been in full charge of the field and office work of land reclassification and canal inspection, and the department was very fortunate in securing the services of an officer so capable and tactful. Mr. Houston is to be congratulated upon bringing to a successful conclusion an exceedingly complicated and difficult task.

It is expected that the classification of irrigable land in the eastern section of this project will be completed during the present year.

SOUTHERN ALBERTA LAND COMPANY.

Reference has been made in the preceding pages to the temporary abandonment of construction work by this company owing to the apparent impossibility of financing the work during the continuance of the war. A concise statement of the company's financial difficulties and of the assistance given by the government by way of loan will be found in the report for last year.

Pursuant to an agreement dated the 31st July, 1914, between the Canadian Government and the Southern Alberta Land Company, *et al.*, the Government has loaned

the company \$354,684, taking as security a mortgage on some 30,000 acres of the company's land. All of this sum has now been paid over to the company, payment having been made as follows:—

July 10, 1914..	\$ 50,000
August 4, 1914..	90,000
September 11, 1914..	100,000
July 16, 1915..	114,684
	<hr/>
	\$ 354,684

The expenditures from this fund up to the 15th April, 1916, have been \$279,634.96, accounts for which have been submitted and audited by this department, leaving an unexpended balance of \$75,049.04, of which \$35,071.27 is in the Bank of Montreal at Medicine Hat, Alta., and \$39,977.77 is in the hands of Sir William Plender, the receiver and manager of the company, in London, England. Some portion of the last-mentioned sum may have been expended by the receiver, but no accounts covering any such expenditures have as yet been submitted.

The company has been unable, as yet, to raise the further sum of \$800,000, which it undertook to raise under the provisions of the agreement previously referred to, and it has therefore been impossible to carry out any one of the several construction programmes submitted by its chief engineer.

The only construction work carried on during the past year has been the repairs to the diversion dam. During the high water in Bow river in June, 1915, a section some 200 feet long, in mid-channel, was washed out. Continued high water prevented repair work for some time, and when it was undertaken later in the season labour was scarce and slow progress was made. The repairs have, however, now been completed at a cost of some \$30,000, and the dam is now believed to be capable of withstanding any flood that is at all likely to occur.

Aside from the repairs to the dam the company has confined its activities to the preservation of the works already constructed, and to the management of its farms and live stock. The company's farming and range operations during 1915 showed a net profit of over \$40,000. The rainfall for the growing season of 1915 was 9.25 inches, as compared with 2.16 inches for 1914, and the excellent crops clearly show what the company's lands will produce when the necessary amount of moisture is applied at the right time, either in the form of rain or irrigation.

The company's total grain crop was as follows:—

	Bushels.
Wheat..	36,260
Oats..	63,025
Barley..	18,912
Speltz..	3,975
Rye..	2,600
Flax..	2,000
	<hr/>
Total..	126,772

The yield of wheat averaged 44 bushels per acre for 826 acres; oats averaged 77 bushels, and barley about 53 bushels per acre, and but a small proportion of the crop was grown on summer-fallowed land.

The company has 570 acres of alfalfa, all of which is grown for seed, for which the demand at present exceeds the supply in so far as this company is concerned.

Unless further funds can be raised at an early date for the completion of the works, so as to get water on some portion of the land, the outlook for the company is none too bright.

THE ALBERTA LAND COMPANY.

This company is practically a subsidiary company to the Southern Alberta Land Company. A tract of some 67,674 acres was sold to Mr. F. P. Aylwin, and by him assigned to the Alberta Land Company. The land is so situated—at the northwest

corner of the Southern Alberta Land Company's tract—that it can most readily be irrigated by water diverted from the works of the latter company. An agreement exists between the two companies whereby the Southern Alberta Land Company has undertaken to build the necessary canals for the irrigation of the Alberta Land Company's tract and to permit of the required quantity of water being diverted through the works of the former company. The main canals have been built, but cannot be used at present, as the works of the Southern Alberta Company are not sufficiently completed to carry water to them. This company is also in financial difficulties, and is in the hands of a receiver. Its present unfortunate position is due, in part at least, to the failure of the firms of Chaplin, Milne, Grenfell and Company, and The Canadian Agencies, Limited, in which most of its funds were invested. There is apparently little probability of the company being able to re-establish itself on a sound financial basis until after the end of the war.

LETHBRIDGE NORTHERN IRRIGATION PROJECT.

This has been designated in previous reports as the "Oldman River Diversion Project," but the new name has now been adopted as more suitable. The project as originally projected provided for the irrigation of some 100,000 acres immediately north of Oldman river in the Lethbridge district, and our surveys were made at the instance of a very considerable number of settlers in that district.

Reference was made in the report for last year to some opposition to the project which had developed among the settlers in the western part of the district, but the extent of that opposition had not at that time fully developed. The settlers in the Barons-Carmangay district have since decided that they do not want to be included in the district, and the plans of the project have therefore been modified so as to exclude these lands.

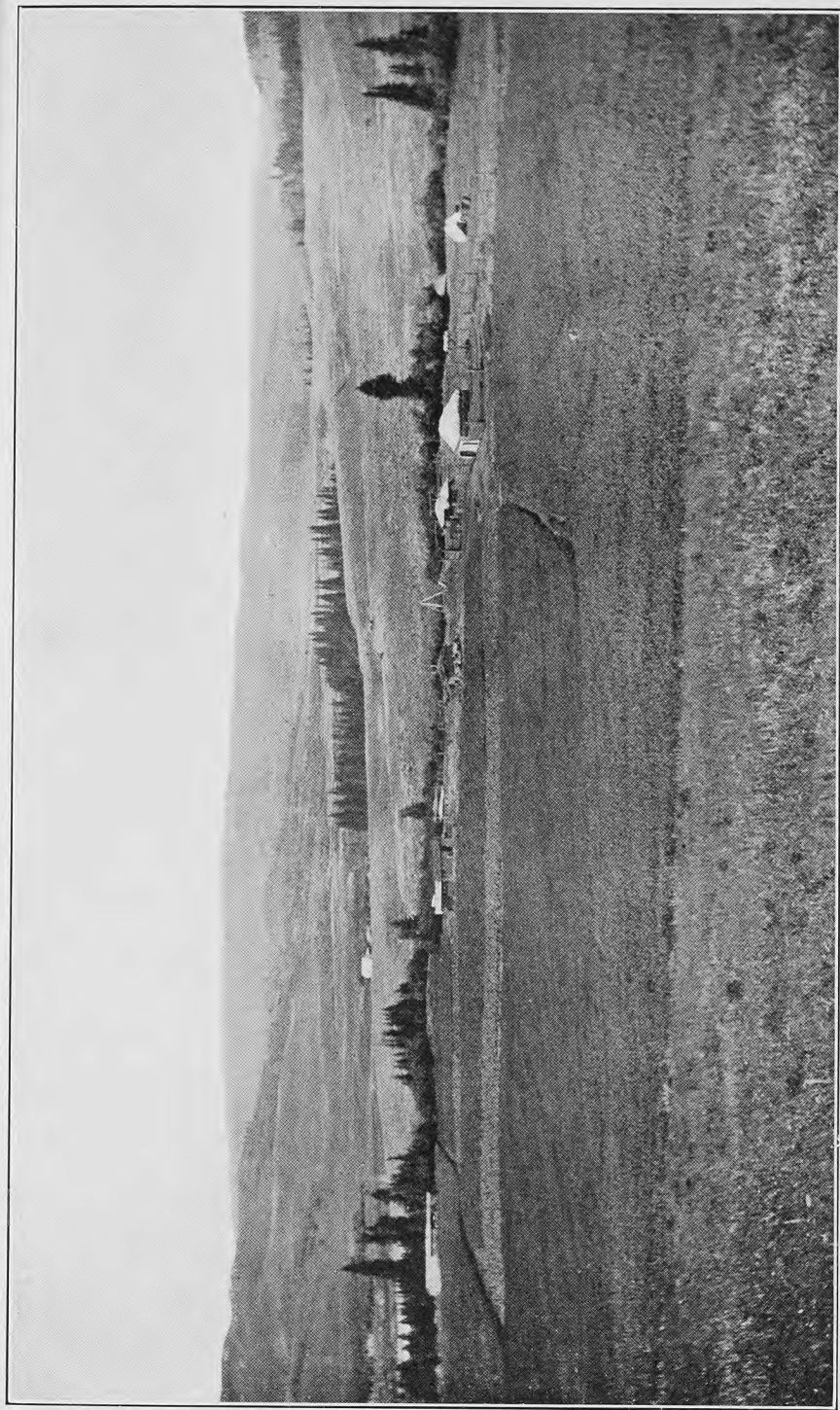
The resultant changes comprise the abandonment of some 35,000 acres of land at the extreme westerly end of the district, the elimination of a storage reservoir at lake Kehoe, the re-location of some twenty-five miles of canal, and the extension of the project to include a small district immediately west of Lethbridge, which was not included in the original plan. It is also believed to be possible to include a considerable area south of Oldman river in the vicinity of the towns of Pearce and Orton, and surveys are now being made to determine the feasibility of this extension and the area that can be served by it.

It is expected that by the end of the season of 1916 all this work will have been completed and that it will then be possible to accurately define all the irrigable land and to give a close approximation of the cost of construction. It will then rest with the settlers to decide whether or not they will organize an irrigation district, under the provisions of the Alberta Irrigation District Act, and raise money for the construction of the works.

TABER IRRIGATION DISTRICT.

There is a considerable area of first-class agricultural land, well adapted to irrigation, lying east of Lethbridge along the line of the Canadian Pacific Railway Company's branch between Dunmore and Lethbridge, in Townships 9 and 10, Ranges 16, 17 and 18, West of the 4th Meridian. Settlers in this district have been seriously affected by frequently recurring years of drought, and, becoming convinced of the value of irrigation as practised in the Coaldale district immediately east of Lethbridge, they endeavoured to arrange with the Canadian Pacific Railway Company for an extension of the canals of that company's Lethbridge system so as to provide for the irrigation of their own lands.

Surveys were made by the railway company, and the project was found to be feasible at reasonable cost. The plan contemplates the storage of water in Chin cou-



A Ranch in the Cypress Hills, Irrigated from Milk Creek.

Taken by M. H. French.

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lee at the eastern end of the company's Lethbridge irrigation system, and its diversion thence, through a canal running in a general easterly direction, through the tract to be irrigated, which lies between the towns of Chin and Taber.

The company's original surveys indicated that approximately 17,000 acres of land could be irrigated in this manner. There was, however, at that time no law in existence under which the interested settlers could organize as an irrigation district, and raise the money necessary for the construction of the canals. The desire for a system of irrigation was, however, so strong that the Government of the province of Alberta was induced, at its session early in the year 1915, to cancel the then existing but out-of-date and unsatisfactory irrigation district law, and to enact a new law under the provisions of which settlers can form an irrigation district and raise money by the sale of bonds secured to their land for the purpose of constructing the necessary works.

Upon the enactment of this law a petition was presented to the Alberta Government for the formation of the Taber Irrigation District, and such a district was subsequently organized. At the same time the prime movers in the case entered into a tentative agreement with the Canadian Pacific Railway Company, whereby that company undertook to construct all necessary works to deliver water at some point on each quarter-section of irrigable land within the district, taking in exchange the bonds of the district for an amount sufficient to cover the cost of the works, estimated at about \$10 per irrigable acre.

Apparently throughout these earlier negotiations no significance was attached to the fact that within the proposed irrigation district, which comprises some 37,000 acres, of which about 19,000 acres are susceptible of irrigation, there are about 13,000 acres of school land, title to which is still vested in the Crown in the right of Canada. Some 8,000 acres of this school land are actually irrigable under the proposed system but, as title to land is still vested in the Crown, inasmuch as the payments thereon have not yet been completed, it is obviously not in the power of the purchasers and present holders of the lands to place a further and prior lien upon them in order to secure the irrigation district bonds, without the consent of the Dominion Government.

Under the provisions of the law respecting the School Endowment Fund, the Dominion Government, acting as the trustee of the fund, is required to invest all the proceeds of the sales of school lands and to transfer the interest thereon, less expenses of management, to the Provincial Governments to be used by them for educational purposes. As the Government of the province of Alberta was the beneficiary in this case, the promoters of the Taber Irrigation District asked it to consent to the taxation of school lands for the purpose of raising funds for the construction of irrigation works under the Irrigation District Act. The Provincial Government transmitted this request to the Dominion Government and asked that legislation be enacted by Parliament to permit of the school lands within this irrigation district being dealt with under the provisions of the Irrigation District Act, in the same manner as though they were patented lands.

The Alberta Irrigation District law provides that the irrigation district bonds shall be a first lien upon all lands within the district. Compliance with the request of the Provincial Government would therefore give these bonds precedence over the claim of the School Endowment Fund for the unpaid portion of the purchase price of the land, and this, it was felt, would be unwise and unfair to the interests of education within the province. Being desirous, however, of meeting the wishes of the Provincial Government and of the settlers within the Taber Irrigation District as far as possible in this matter, an Act was passed by the Dominion Parliament assenting to the inclusion of school or Dominion lands within the boundaries of the Taber Irrigation District, but providing that, in the event of any such lands being sold under the provisions of the Irrigation District Act, the sale price shall include an amount sufficient to fully satisfy the prior claims of the Crown.

The practical effect of the Dominion legislation is to make the irrigation district bonds a second mortgage on the school lands within the district. It is understood that this is not satisfactory to the Canadian Pacific Railway Company and that it will probably decline to accept the bonds of the district. If such proves to be the case, the project may have to be abandoned or extended in an easterly direction so as to include a further area of irrigable land to replace the school lands, which, for the most part, lie in the westerly portion of the district.

It is unfortunate that any legal difficulties should prevent the irrigation of land in this vicinity, as it is peculiarly well adapted to irrigation and quite a little money has already been expended by those interested in the formation of the irrigation district. The difficulty respecting school lands should, however, have been considered by the interested parties at an earlier stage of the proceedings.

HYDROMETRIC SURVEYS.

The work of stream measurement has been carried on systematically and has been extended to include the upper tributaries of the North Saskatchewan and Athabaska rivers, and the Peace river at Fort Vermilion. Increased attention has been given to winter measurements, which are so important in power development. One of our engineers, Mr. P. H. Daniells, was stationed at Fort Vermilion throughout the winter of 1915-16, for the purpose of measuring the flow of Peace river at that point and at Vermilion chutes, some 65 miles lower down the same stream. The unpleasant nature of his work may be imagined when it is known that the average minimum daily temperature for January, 1916, was 36 degrees below zero, the lowest recorded temperature being 65 degrees below zero. Cutting holes in the ice across a stream 1,100 feet wide and handling a current meter in such weather is not an ideal occupation.

A full report of this important branch of work will be published separately at an early date.

DRAINAGE.

Very little drainage work has been undertaken during the past year, and there is little present prospect of much activity in the near future. A good many applications have been made for permission to drain large areas of submerged or swampy lands in remote districts, and for the purchase of the land to be reclaimed, but it is not considered to be good policy to encourage such enterprises while large areas of swampy land in nearer and more thickly settled districts are awaiting reclamation. Several promising reclamation projects are being held up because their active promoters are now in military service.

From time to time complaints are received that the drainage of a lake or swamp has resulted in damage to the land of someone in the neighbourhood. Upon inquiry, or inspection by our engineers, it is usually found that some settler, or group of settlers, has undertaken the work for the purpose of reclaiming waste land forming part of his own farm, and that those responsible for the work have not been aware that their action was illegal. It has generally been found possible to reconcile the apparently conflicting interests, and most of this kind of work of which we have knowledge has really been beneficial, although without legal warrant.

In a few cases rather serious damage has been done by illegal drainage operations, and in one notable case the injured person has brought an action for damages against those responsible. The result of this action is not yet known, but it is to be hoped that a conviction will have a deterrent effect upon others who may contemplate similar action. There is no excuse, other than ignorance of the law, for the illegal drainage of small areas of submerged or swampy land. The provincial "Private Ditches Acts" provide simple and adequate means for carrying out all reasonable projects of this nature, and the consent of the Dominion Government can readily be obtained for the draining away of any bodies of water which may be affected and which are controlled by the Crown under the Irrigation Act.

PERSONNEL.

There have been a great many changes in the staff during the year. Thirty-eight of our officers have enlisted for active service. In thirteen cases it was found necessary to appoint substitutes for the absent officers in order to efficiently carry on the work, but in the remaining cases, by curtailing the work and re-arranging the staff, it was found possible to avoid this. Two other officers have applied for permission to enlist, but have not yet actually enlisted, and another officer is serving with the Militia in Canada. Several other officers have offered their services but have been found physically unfit, and in still other cases married officers are anxious to serve but feel that in justice to their families they cannot volunteer at present. No officers who have asked permission to enlist have been refused.

These numerous changes in the staff, the absence of many of our more experienced officers, and their replacement by others unfamiliar with the work, have thrown a great deal of extra work and responsibility upon our principal officers and have necessitated the temporary lengthening of working hours, but there has been little or no complaint, and an earnest effort has been made to keep up the work.

The following list of officers who have enlisted for active service may fittingly be called "Our Honour Roll":—

1 J. M. H. Wilkes.....	Leveller.....	Enlisted Aug. 16, 1914....	Trooper, Royal Can. Dragoons.
2 E. S. McMillan.....	Draughtsman....	" 21, 1914....	Sapper, Can. Div'l Engineers.
3 W. E. Dow ¹	Draughtsman....	" 22, 1914....	Q.M.S., Div'l Cyclists.
4 C. V. Craik.....	Ass't Engineer....	" 22, 1914....	Corporal, Can. Div'l Engineers.
5 E. S. Clifford.....	Hydro. Ass't....	" 24, 1914....	Major, Ass't. Provost Marshal, Can. Contingent.
6 R. V. Muller.....	Leveller.....	" 26, 1914....	Trooper, Royal Can. Dragoons.
7 C. E. Vrooman.....	Leveller.....	Sept. 26, 1914....	Sapper, Can. Div'l Engineers.
8 C. P. Maxted.....	Rodman.....	" 26, 1914....	Sapper, Can. Div'l Engineers.
9 H. E. Bowden.....	Teamster.....	" 26, 1914....	Sapper, Can. Div'l Engineers.
10 J. S. Ferrier.....	Draughtsman....	Nov. 6, 1914....	Lieutenant, Northumberland Fusiliers.
11 H. D. St. A. Smith.....	Ass't Engineer....	" 9, 1914....	Lieutenant, Can. Div'l Engineers.
12 C. B. Hornby.....	Accountant.....	" 16, 1914....	Lieutenant, 31st Battalion.
13 D. C. McDougall.....	Accountant.....	" 19, 1914....	Q.M.S., Can. Div'l Engineers.
14 G. H. Nettleton.....	Hydro. Ass't....	Jan. 4, 1915....	Sgt., 12th Mounted Rifles.
15 H. S. Kerby ²	Engineer.....	Feb. 11, 1915....	Lieutenant, Royal Aviation Corps
16 J. H. Jones.....	Ass't Engineer....	Apr. 26, 1915....	Captain, 56th Battalion.
17 E. W. W. Hughes.....	Engineer.....	May 8, 1915....	Private, 53rd Battalion.
18 G. R. Elliott.....	Engineer.....	Aug. 16, 1915....	Lieutenant, Div'l Cyclists.
19 W. T. White.....	Ass't Engineer....	" 16, 1915....	Lieutenant, 1st Pioneer Battalion.
20 H. W. Cheney.....	Ass't Engineer....	Sept. 29, 1915....	Lieutenant, 4th University Com- pany.
21 W. E. Hunter.....	Accountant.....	Oct. 2, 1915....	Sgt. Major, 77th Battalion.
22 E. L. Hornby.....	Draughtsman....	" 12, 1915....	Private, 1st Pioneer Battalion.
23 J. Cawthorn.....	Clerk.....	" 14, 1915....	Private, 1st Pioneer Battalion.
24 H. B. R. Thompson.....	Engineer.....	Nov. 8, 1915....	Private, 1st Pioneer Battalion.
25 F. R. Burfield.....	Engineer.....	Dec. 31, 1915....	Corpl. No. 2 Tunnelling Co.
26 W. G. Guthrie.....	Draughtsman....	Feb. 20, 1916....	Private, Army Medical Corps.
27 L. E. M. Shenton.....	Draughtsman....	" 24, 1916....	Sapper, Australian Imperial Forces.
28 W. B. Hutcheson.....	Ass't Engineer....	Mar. 13, 1916....	Lieutenant, Can. Div'l Engineers.
29 H. R. Carscallen.....	Engineer.....	" 31, 1916....	Lieutenant, Can. Div'l Engineers.
30 W. R. McCaffrey.....	Engineer.....	" 31, 1916....	Sgt., 4th Div'l Cyclists.
31 R. E. Matheson.....	Hydro. Ass't....	" 31, 1916....	Sapper, Can. Div'l Engineers.
32 P. J. Jennings.....	Engineer.....	Apr. 1, 1916....	Captain, and Adjutant, 4th Pioneer Battalion.
33 G. H. Whyte.....	Engineer.....	" 4, 1916....	Lieutenant, Can. Div'l Engineers.
34 T. H. Burt.....	Hydro. Ass't....	" 4, 1916....	Private, Army Medical Corps.
35 R. H. Goodchild.....	Engineer.....	" 22, 1916....	Lieutenant, 4th Pioneer Battalion.
36 L. J. Gleeson.....	Ass't Engineer....	May 9, 1916....	Gunner, 50th Queen's Battery.
37 F. K. Beach.....	Engineer.....	" 21, 1916....	Lieutenant, 211th Battalion.
38 J. M. Paul.....	Engineer.....	" 22, 1916....	Gunner, 50th Queen's Battery.

¹W. E. Dow was wounded and subsequently invalided home; he resumed work in the department on the 12th December, 1915.

²H. S. Kerby was invalided home and resumed work in the department on the 25th April, 1916.

Mr. N. M. Sutherland, Divisional Hydrometric Engineer, is on leave without pay, and is serving as Officer Commanding Royal Canadian Engineers for the 13th Military District, at Calgary, Alta.

Messrs. J. S. Caughey and O. H. Hoover, Hydrometric Engineers, have volunteered but have not yet enlisted.

I regret to report the death of Mr. George D. Walters on the 14th January, 1916, after a very brief illness. Mr. Walters entered the service of this branch on the 2nd May, 1913, as an agricultural engineer, and had considerable previous experience in this line of work. He was most attentive to his duty and had displayed considerable ability in its performance. It is a matter of sincere regret that his promising career should have been ended so suddenly at the early age of thirty-one years.

PRACTICE OF ECONOMY.

The sum appropriated by Parliament for the work of this branch for the fiscal year 1915-16 was \$268,000. The estimates were prepared and approved in September, 1914, when the seriousness of the war and its probable duration were not as fully comprehended as they now are. As these conditions became more apparent every effort was made to economize. Some investigations which had been planned, and for which provision had been made in the Estimates, were abandoned and only the really necessary work was carried on. The result is that we have expended only \$243,500, thus effecting a saving of \$24,500.

REVENUE.

Appended hereto is a statement of the revenue received and accounted for by this branch during the year ended the 31st March, 1916. This consists chiefly of payments made on account of land sold for reclamation by irrigation, the balance being made up of rentals for reservoir leases, fees paid for water licenses and for the registration of water and other agreements.

Lethbridge agency.. . . .	\$ 708 11
Calgary agency.. . . .	1,809 59
Medicine Hat agency.. . . .	7,214 61
Swift Current agency.. . . .	486 70
Maple Creek agency.. . . .	5,325 60
Irrigation Branch, Calgary.. . . .	512 00
Irrigation Branch, Ottawa.. . . .	1,435 73

Total.. . . . \$17,492 34

Your obedient servant,

E. F. DRAKE,

Superintendent of Irrigation.

REPORT ON IRRIGATION AND CANADIAN IRRIGATION SURVEYS.

By F. H. PETERS, Commissioner of Irrigation and Chief Engineer.

E. F. DRAKE, Esq.,

Superintendent of Irrigation,

Department of the Interior,

Ottawa.

SIR,—This report contains the more important reports submitted by the engineers employed in charge of work on irrigation and irrigation surveys, together with a summary report on the duty of water work and irrigated crop reports. All of the data gathered in connection with the Hydrometric Surveys Branch are being submitted in a separate report on the progress of stream measurements.

This general introductory report by the commissioner is intended merely to give in very brief form an outline of all the work carried on, with the most interesting details noted indicating the scope of the work.

ORGANIZATION OF STAFF.

The organization of the staff was very similar to the previous year. The staff has two main divisions in the permanent office staff and the permanent field staff which is augmented each summer by subordinate assistants for carrying out the field work. As a large number of engineers and other employees were granted military leave of absence to go on active service during the year, a good many changes in the staff were made necessary. Nearly all of the permanent employees, who went on active service were replaced, and thus while the personnel changed, the number of employees remained practically the same. The total number of persons employed on the permanent office staff was twenty-six, and on the permanent field staff thirty-six. On the Canadian Pacific Railway western section re-classification, the field and office staff numbered fifteen persons. This gives a grand total of permanent officers of seventy-seven and, including the summer assistants, one hundred and seventy.

OFFICE WORK.

The office work carried out is indicated by the schedule below, which is given in a similar form to previous years for purposes of comparison:—

Letters received.. . . .	14,721
Letters sent.. . . .	22,959
Applications for water rights recorded.. . . .	50
Plans examined and filed.. . . .	285
Agreements, right of way, etc., recorded.. . . .	62
Right-of-way plans recorded in quadruplicate.. . . .	40
Water Agreements filed in quadruplicate.. . . .	254
Water Agreements cancelled.. . . .	335
Water Agreements transferred.. . . .	90
Notices for publication prepared.. . . .	64
Plans prepared.. . . .	964
Blue prints made.. . . .	17,200
Certificates issued under Section 20.. . . .	60
Certificates issued under Section 33.. . . .	41
Licenses recorded, in triplicate.. . . .	62
Weekly reports received from engineers.. . . .	2,444
Reports of discharge measurements received.. . . .	3,852
Reports of gauge heights received.. . . .	7,358
Descriptions of regular gauging stations H. 1.. . . .	144
Reports of changes at river stations, H. 22.. . . .	289

STREAM ADMINISTRATION.

During the year the commissioner made a study of a new system of stream administration, which was later completed in detail by Mr. R. J. Burley. Under the new system it is proposed to deal with applications for the use of water by drainage basins, rather than by separate streams, as under the present method of administration. The old system is considered to be fundamentally wrong, as it fails to recognize the rights of the prior appropriation, on the main stream of a drainage basin, as against subsequent appropriation on the tributaries to this main stream above them. It is the intention to put the new administration in force as soon as the staff available to complete the very great amount of work necessary will allow.

FIELD WORK.

The field work which was carried out is indicated below, subdivided under the headings of the field parties which carried out the work.

Eastern Cypress Hills District—Irrigation Inspections.—This work was confined to nearly the same district as in the previous year, the boundary between the east and west districts being shifted about one township to the west in order to more nearly

equalize the amount of field work in each district. The work was efficiently carried out by Mr. M. H. French, the engineer in charge. The party took the field on April 25, 1915, and finally disbanded on December 10, completing a season of 184 working days. The total number of inspections made was 113, the number of schemes surveyed was nine, and in addition to this, right-of-way surveys were made across sixty-seven quarter-sections of land. The number of miles surveyed by team was 2,285. The very large number of right-of-way surveys took an undue portion of the time of the party, and made it necessary that the ordinary routine work be curtailed as much as possible, which condition was undesirable, but could not be avoided. The party consisted of five men with five horses.

Western Cypress Hills District—Irrigation Inspections.—This work was also confined to the same district as in the previous year, with the alteration of the dividing line between the districts, as noted under the eastern district. The work was efficiently carried out by Mr. H. R. Carscallen, the engineer in charge. The party took the field on April 26, 1915, and disbanded on November 19, the engineer making a further inspection trip with one assistant, ending on December 1. The season's work comprised 190 actual working days. The total number of inspections made was ninety-two, the number of schemes surveyed was forty-two, and in addition to this, eighteen right-of-way surveys were made. The number of miles travelled by team was 3,515, and by railway 579. The routine work of inspection of this party also suffered on account of the large number of surveys which had to be made, but as in the eastern district, this could not be avoided. The party consisted of six men with eight horses.

Calgary District—Irrigation Inspections.—The work was confined to the same district as in the previous year, but the difficulty of transportation, owing to the very heavy roads, due to the wet season, hampered the work considerably, and a few of the more outlying schemes were not inspected. The work was again carried out by Mr. R. H. Goodchild, who had one assistant and one team of horses. The work was commenced on April 26, 1915, and ended on December 15, when the severity of the weather made it impossible to continue any longer. The season comprised 175 actual working days, of which twenty-one were spent in the Calgary office, plotting plans, and on special stream measurements, during the period of extreme flood in the streams in the district. The total number of schemes inspected was 100, the number of schemes surveyed was seventeen. The number of miles travelled by team was 1,460, and by train 640.

Special Inspections—Domestic, Municipal, Irrigation and Industrial.—This work was carried on under the supervision of Mr. P. J. Jennings, the office engineer. The routine work as office engineer consists mainly of examining and checking all plans, prepared by the inspecting engineers, or submitted by applicants for water rights or other purposes. In addition to this, Mr. Jennings supervised the work of the two special inspectors, and saw that for each trip the inspections were properly grouped, as regards economy in time and travel, and the urgency of an early report. Owing to the very scattered location of the inspections, this is very often a matter requiring considerable judgment.

Mr. C. Chambers carried out the inspections in Alberta, totalling seventy-one in number, and made six surveys of all descriptions. He travelled 6,550 miles by train and 2,367 miles by team.

Mr. F. R. Burfield carried out the inspections in Saskatchewan, totalling seventy-eight in number, and made thirty-seven surveys of all descriptions. He travelled 10,152 miles by train and 2,068 miles by team.

Mr. Jennings examined and checked 206 plans of all descriptions, and fifty-six descriptions for right-of-way. He also personally made five inspections in the field, which required special attention.

Large Irrigation Companies.—Progress Reports.—Mr. S. G. Porter, Assistant Chief Engineer, again devoted the bulk of his time to special supervision of the large

irrigation companies. In addition, he had under his special charge the approval of the classification of irrigable land in the eastern section of the Canadian Pacific Railway Company's irrigation block, and in the proposed Taber irrigation district.

The Southern Alberta Land Company did not carry on any construction work during the year, other than repairs to their diversion dam in the Bow river, but the conditions at this point were reported on from time to time. During the flood in the Bow river in June, 1915, a part of the dam in the south channel failed and the concrete apron below the dam in the north channel was damaged. This latter damage has been repaired, and the construction of a new dam, bridging the portion that failed in the south channel, is under way.

The Canadian Pacific Railway Company's Lethbridge section (Alberta Railway and Irrigation Company) was successfully operated during the season, but no field inspection of the works was made.

Classification of Irrigable Land—C.P.R. Eastern Section.—One field party consisting of six men, all told, with six horses, was put in the field under Mr. J. S. Tempest, who had as his assistant Mr. P. A. Fetterly. The party commenced this work on April 12, 1915, and continued until October 1, when it was shifted to the Taber irrigation district. This party continued the work which was carried on during the previous season. An irrigable area, of approximately 126,000 acres, was inspected, but further investigations of the drainage and alkali conditions are necessary in respect to a part of this area.

Classification of Irrigable Land—Taber Irrigation District.—The Taber irrigation district has been organized by the farmers between Chin coulee and Taber under the provisions of the Provincial Irrigation District Act.

The district contains about 20,000 acres of first-class irrigable land which can be irrigated by a proposed canal taking out of Chin Coulee reservoir, already constructed by the Alberta Railway and Irrigation Company. The water will be supplied to the reservoir through the main canal of the Alberta Railway and Irrigation Company's system during the non-irrigation season, and at times of surplus supply during the irrigation season.

A study of the water supply indicates that there is an ample supply available for 17,000 acres, and it is proposed to limit the area to be served to that amount.

The field party under Mr. Tempest, which had been engaged in the classification of Canadian Pacific Railway Company's eastern section lands, made a thorough classification of the lands in the Taber irrigation district, from October 2 to November 23, 1915.

Reclassification of Irrigable Land—C.P.R. Western Section.—The reclassification of irrigable land in the Canadian Pacific Railway western section was continued under the charge of Mr. G. N. Houston. His chief assistant, Mr. R. C. Spitzer, had special charge of the work in the office. One large field party, consisting of three assistant engineers and fourteen other men, took the field on April 15, 1915, and completed the work on September 9, when Mr. Houston came into the office, and the remainder of the party were transferred to work on the Lethbridge Northern Project. Provision was made for the employment of eleven assistant engineers in the office, but this number was reduced after the middle of the summer, when it was found that a smaller number was able to keep up the work.

A summary of the seasons reclassification is as follows:—

	Acres.
Irrigable.. . . .	53,628
Non-irrigable.. . . .	97,560
Right of way.. . . .	3,700
Total.. . . .	154,888

During the winter months Mr. Houston completed his final report on the whole work of reclassification in the western section.

Irrigation Surveys.—Mr. B. Russell, Chief Field Inspector, again had supervision of the irrigation surveys that were carried on during the year. The work was developed by four parties, as indicated hereunder.

The Lethbridge Northern Irrigation Project.—This work previously reported on as the Oldman River Irrigation Project was commenced in 1913. At the end of 1914 the work had progressed to the extent of the actual location of all main and secondary canals, and the commanded area had been determined by levels run over all section lines. During 1915 the work consisted of making plane table surveys of each section of land to determine the definite irrigable area. The party commenced work in the southeast end of the project, where the farmers were most anxious for irrigation, and covered practically all of the project lying south and east of Noble.

During the winter months a farmers' meeting was held at Barons, at which the farmers living north and west of Noble decided that they did not want irrigation. This has made necessary a change in the layout of the project to serve only those lands where the farmers want irrigation. This makes Lake Keho reservoir unnecessary, and the small project is quite as feasible and can be constructed for the same cost per acre as the original project. As the amended project now stands, the only field work remaining to be done at present is the plane tabling of about eleven sections of land, and the re-location of about 25 miles of main canal.

Mr. V. M. Meek, the engineer in charge, took the field on April 29, 1915, and disbanded his party on November 22, completing a season of 179 actual working days. Mr. Meek was given three assistant engineers, who operated three plane tables, and the party consisted of fifteen men, all told, with ten horses. On September 17, 1915, the party from the Canadian Pacific Railway western section was transferred to this work. This party also operated three plane tables, and put in fifty-five actual working days, disbanding for the season on November 19. During the season the total work done on this project comprised the contouring of 149,515 acres of land, and the running of 315 miles of levels.

Milk and St. Mary Rivers—Irrigation Project.—This work was commenced in 1914. During that season the main canal locations were developed from the St. Mary river, were partly developed within the tract, and the available reservoir sites were reconnoitred. Also levels were run over the township lines for the whole area to be developed, thus allowing the commanded area to be approximately determined.

The area of irrigable land which can be served under this project depends very largely on the maximum development cost per acre which is assumed. In addition to this, the quantity of water which will be available to Canada from the Milk and St. Mary rivers is not known definitely. Accepting the larger figure of irrigable area and the legal duty of water, the surveys made last year made it apparent that to ensure an adequate supply of water it would be necessary to tap the Waterton river as well as the Belly river.

Party No. 1, under the charge of Mr. T. M. Montague, with Mr. L. J. Gleeson as assistant, was first employed in locating a feeder canal which would convey water from both the Waterton and Belly rivers, and deliver it into the St. Mary above the proposed intake from that river. The party then surveyed several reservoir sites, located some main canals through the irrigable tract, and carried out some levelling to develop topographical features. This party took the field on April 23, 1915, and disbanded on November 2, completing a season of 162 actual working days. A summary of the season's work is as follows: 372 miles of traverse line, complete with topography; 449 miles of level line only, and 120 miles of flying levels; six permanent iron bench-marks were set, and four others were tied into mean sea-level datum. The party consisted of thirteen men, with eight horses.

Party No. 2 was operated under the charge of Mr. N. M. Sutherland, with Mr. A. W. P. Lowrie as assistant. The work of this party was confined to the development of information within the tract of irrigable land, and comprised the development of reservoir sites, the location of canals, and the closer development of topo-

graphical features by running levels along section lines. The party took the field on April 22, 1915, and disbanded on November 11, completing a season of 172 actual working days. A summary of the season's work is as follows: 430 miles of traverse, complete with topography, and 1,133 miles of levels along road allowances. The party consisted of eleven men, with eight horses.

Milk River Traverse Survey.—Under the terms of Article VI of the Waterways Treaty, the United States has the privilege of utilizing the channel of Milk river in Canada for the conveyance of water diverted from the St. Mary river. It is probable that the conveyance of this added quantity of water will cause damage to the river bottom-lands along the Milk river. The United States is expected to turn some water into the Milk river during 1916, and so it was decided to make a careful survey of the river channel in Canada to determine the actual conditions existing before any water was turned in.

A party was organized under the charge of Mr. W. Edwards, D.L.S., who had as his first assistant, Mr. E. L. Miles. The survey was carried on by making a careful stadia survey of both banks of the river, taking frequent cross-sections of the river-bed and bottom-lands, and in addition taking exhaustive topographic notes showing all the river bottom-lands liable to injury. An accurate line of levels was carried along, and the survey was carefully tied on to the government land survey monuments throughout its entire length. The party took the field on July 3, 1915, and was disbanded on November 29, completing a season of 103 days actually on the line. A summary of the season's work is as follows: Length of stadia traverse line, 180 miles; length of river meander surveyed, 216 miles; river cross-sections taken, 131; ties to survey monuments, forty-three; set twenty-four permanent iron bench-marks. Up to the middle of September, the party consisted of twelve men, all told, transportation being by means of three large canoes. Later the party was increased to fourteen men, all told, with one team of horses.

International Waterways Treaty.—Mr. R. J. Burley again had charge of the special investigations in connection with this work. Early in April a conference concerning the terms of the treaty was held at Washington, D.C., and in the latter part of May the case was fully argued before the International Joint Commission at St. Paul, Minnesota. Both these meetings were attended by Mr. Burley and the commissioner, in company with other Canadian Government officials, including the superintendent of irrigation. During the summer, Mr. Burley made a trip in the field in order to familiarize himself with certain of the international streams, and early in November went to New York City to attend an executive session of the Joint Commission. Shortly after the New Year his headquarters were transferred to Ottawa in order that his services might be more readily available, now that this case has reached the stage of settlement before the Joint Commission.

Duty of Water Experiments and Demonstration.—This work was again somewhat extended during the year, under the supervision of the late Mr. G. D. Walters, who had direct charge at Strathmore in the Canadian Pacific Railway western irrigation block of the dual work of conducting a series of special duty of water experiments and demonstrations and also conducting demonstration work on the irrigated farms in the close vicinity of Strathmore.

Mr. J. E. Degnar had charge of the work in the Coaldale district of the Alberta Railway and Irrigation Company's project at Lethbridge, and his work was devoted to measuring the actual quantities of water applied to the irrigated fields in this district, gaining all information possible with a view to demonstrating what is the proper and most beneficial duty of water.

Mr. W. H. Snelson was placed in the Gleichen irrigation district with a view to carrying on work in a similar manner to the Coaldale district. Owing, however, to the very wet season, very little water was used here, and so the data gathered were meagre.

Through the courtesy and co-operation of the Southern Alberta Land Company some very useful data were also compiled covering the use of water on their irrigation demonstration farm at Ronalane near Medicine Hat.

During a very wet year like the past one has been, it is impossible to get as complete experimental data as during the drier years, because with the high natural precipitation it is impossible to note the crop growth with very small quantities of water and then observe step by step the results that are gained by applying increasing depths of water, and the demonstration work is not so satisfactory, because in the very wet years the farmers do not give so much attention to irrigation. As the climate cannot be made to order, however, it is equally as important to note the results in a wet year as in a dry year in order to determine average results.

Mr. G. D. Walters, the officer in charge of this work, died very suddenly in January, 1916. Mr. Walters had shown great ability and enthusiasm in his work, and his death was a great loss to the staff.

Absorption losses in Irrigation Canals.—Investigations of this important subject were continued during the year, a joint report being submitted by Mr. R. J. McGuinness and Mr. L. E. Kendall, who was transferred for the summer from the Ottawa station. The work was considerably hampered on account of the wet weather, which caused local run-off into the canals, but some records were obtained which will be very valuable in the future, when after further work all the data will be compiled and studied.

These same engineers, in co-operation with Mr. C. L. Dodge, hydrometric engineer on the Canadian Pacific Railway staff, carried out a series of experiments for the determination of the co-efficient "N" in Kutters formula, on chosen stretches of the main canal in the Canadian Pacific Railway western section. Owing to the inability to operate the canal as desired, this work, while showing interesting results, was unterminative.

Hydrometric Surveys.—This work, covering the measurement of the flow in all the important streams in Alberta and Saskatchewan, has a very wide scope, and it is only possible in this summary report to indicate the work that has been carried out. The results of the work in detail will be published in a separate report on stream measurements. The organization during 1915 was similar to the previous year. The staff consisted of Mr. P. M. Sauder, Chief Hydrometric Engineer, and two chief assistants, Mr. G. H. Whyte and Mr. G. R. Elliott, with one recorder, one computer, and one clerk in the office. Fifteen assistant engineers were employed in the field. The territory was divided into thirteen districts, two new districts, Nordegg and Peace River being added to the territory covered in 1914.

During the open-water season, records were taken at 184 regular gauging stations on streams in Alberta and Saskatchewan, and at 115 regular gauging stations on irrigation canals and ditches. Winter records, which are so valuable for power investigations and municipal water supplies, received special attention, and records were secured on nearly all the important streams in the two provinces.

During the early spring three of the irrigation inspecting engineers assisted in collecting the records of early spring run-off in the Cypress Hills districts.

Current-Meter Rating Station at Calgary.—The rating station was operated as usual, and a total of seventy-five meters were rated as below:—

Irrigation Branch.....	56
British Columbia Hydrographic Surveys.....	9
British Columbia Water Rights Branch.....	3
Manitoba Hydrographic Surveys.....	4
Water Power Branch.....	1
Department of Public Works, Canada.....	1
Canadian Pacific Railway.....	1
Total.....	75

Honour Roll.—Thirty-four members of the staff at Calgary have enlisted for active service since the commencement of the war. The list showing these gentlemen's names,

appended below, includes eight members of the temporary summer staff, who enlisted while still in the employ of the branch; their names have been marked with an asterisk, to distinguish them from the permanent employees:—

W. E. Dow	J. H. Jones	W. R. McCaffrey
E. S. McMillan	E. W. W. Hughes	H. R. Carscallen
C. V. Craik	G. R. Elliott	G. H. Whyte
J. W. H. Wilkes *	W. T. White	P. J. Jennings
E. S. Clifford	E. L. Hornby *	T. H. Burt *
R. V. Muller*	J. Cawthorn	R. H. Goodchild
C. E. Vrooman *	H. B. R. Thompson	L. J. Gleeson
J. S. Ferrier	C. P. Maxted *	F. K. Beach
H. D. St. A. Smith	H. E. Bowden *	J. M. Paul
C. B. Hornby	F. R. Burfield	L. E. M. Shenton
C. H. Nettleton	W. G. Guthrie	
H. S. Kerby	R. E. Matheson *	

Respectfully submitted,

F. H. PETERS,
Commissioner of Irrigation and Chief Engineer.

SUMMARY REPORT ON DUTY OF WATER AND IRRIGATED CROP REPORTS FOR 1915.

(PREPARED BY F. H. PETERS, COMMISSIONER.)

A complete report of this work has been submitted separately¹ and this summary merely outlines the scope of the work which was carried out and deals very briefly with the most interesting features of the duty of water work at Strathmore, Ronalane, and Lethbridge, all in Alberta, and submits for record the bare details of the most important information gained.

SCOPE OF WORK.

Experimental plot work on the proper duty of water was carried out at Strathmore and Ronalane; data regarding the duty of water were collected at Coaldale, near Lethbridge, and Gleichen, both in Alberta; and irrigated crop reports were submitted by the inspecting engineers for the East and West Cypress Hills districts in Saskatchewan, and for the Calgary district in Alberta.

DUTY OF WATER—GENERAL.

It is to be pointed out that there is a very clear distinction between the work which has been done in the various districts. At Strathmore and Ronalane, experimental plot work is carried on. At these places the same crop is grown on several plots under exactly similar conditions of soil, preparation, and seeding. Water is applied to these plots in varying quantities, and the difference in results is then definitely known to be due to this one element. At the other places it is only possible to collect and compile data showing what results have been gained by different farmers irrigating their land, and the difference in results cannot always be definitely compared because of differences in soil conditions and cultural methods between the different fields.

¹ Not printed.

At the Strathmore experimental plots the work was carried on in the same manner as described in Bulletin No. 4, Irrigation Series, covering the work done in 1914. The wheat, oats, barley, and peas were all ruined by a very severe hail storm, and no results were obtained for these crops. This occurrence, while unfortunate as upsetting the experimental work, served as a very useful object lesson, because while the grain was ruined except for green feed, the alfalfa and the grasses had nearly all been cut, and suffered only minor injury. This shows that the extended growth of alfalfa and the grasses is a great factor of safety against the loss of crop from the hail peril. The data regarding the alfalfa and other crops will be dealt with briefly later.

At the Ronalane experimental plots the season's programme was successfully carried out along the same lines as during 1914 and the data gathered will be briefly dealt with later. These plots are operated by the Southern Alberta Land Company in co-operation with the Irrigation Branch.

An agricultural engineer was placed in the Gleichen district to carry on irrigation demonstration work with the farmers. Arrangements were made with eleven farmers, nine of whom were going to irrigate wheat or oats. The precipitation during the season proved to be sufficient for the grain crops and one of the alfalfa crops which was sown in the spring; the other alfalfa field was not irrigated, although this would have increased the second cutting. The engineer gained a great deal of very useful general data, but these are not worthy of mention in this brief summary.

In the Coaldale district the work was carried on in a similar manner to the work done in 1914. Data were obtained from nineteen fields and will be briefly commented on later. It should be noted that in the Coaldale district irrigation is a well established practice, and the farmers are well instructed in the art. The quantity of water applied to the fields in this district may, therefore, be considered as approaching the proper duty.

In the eastern and western Cypress Hills districts and in the Calgary district, the respective inspecting engineers submitted reports on the crops which were grown under irrigation. On account of the very wet season very little water was used for irrigation in these districts, and no comment on these crops is made in this summary further than to note that the reports have been submitted.

CLIMATIC CONDITIONS.

The year 1915 was a very wet year, the precipitation being well above the average and bumper grain crops were produced without the aid of irrigation in Alberta and Saskatchewan.

A general comparison of the very lean crops from the dry-land grain farms in the dry year of 1914 and the bumper crops from the same farms in the wet year of 1915 proves most conclusively what a vast difference in production is caused by a sufficient supply of water to the crops.

DUTY OF WATER PLOTS—STRATHMORE—ALBERTA, 1915.

The duty of water experiments have not been carried on over a sufficiently long period as yet to allow of definite statements being made which are applicable to average conditions, but some of the results of the work at Strathmore, Ronalane, and Lethbridge are considered to be of sufficient interest to bear repetition in this summary report.

DUTY OF WATER PLOTS—STRATHMORE—ALBERTA, 1915.

TABLE No. 1.

Alfalfa—Sown 1914.

Plot No.	Variety.	Acs.	IRRIGATION.			Precipitation in feet.	Total depth of water received.	FIRST CUTTING.		SECOND CUTTING.		Total yield per acre.
			No.	Date.	Depth applied.			Date.	Yield.	Date.	Yield.	
					Ft.		Ft.		Tons.		Ton.	Tons.
1	Turkestan..		1	Aug. 4....	.25	1.44	1.69	July 19...	.88	Sept. 4...	.737	3.23
2	"		1	" 4....	.50	1.44	1.94	" 16...	1.09	" 2...	.763	3.70
3	"			"		1.44	1.44	" 16	1.235	" 3...	.705	3.88
4	"		1	" 4....	1.00	1.44	2.44	" 16...	1.005	" 2...	.675	3.36
6	Grimm....			"		1.44	1.44	" 6...	.835	" 3...	.623	2.92
8	"		1	" 4....	.25	1.44	1.69	" 6...	.970	" 3...	.675	3.29
10	Montana...		1	" 7....	.50	1.44	1.94	" 6...	.830	" 3...	.652	2.96
12	"		1	" 7....	1.00	1.44	2.44	" 6...	.875	" 3...	.683	3.12

The precipitation noted is from April 1 to September 30. For plots Nos. 10 and 12, the high level of the ground water (approximately 2½ feet below the surface), with the consequent lower soil temperature, is partially responsible for the lower yields obtained. The principal effect noticeable when water was applied under those conditions, *i.e.*, high water table, was that flowering was retarded for a short period on the plots receiving 0.5 and 1.0-foot irrigations.

TABLE No. 2.

Red Clover—Sown 1914

Plot No.	Area.	First Date.	Cutting Yield.	Second Date.	Cutting Yield.	Yield per Plot.	Yield per Acre.
	Acs.		Lbs.		Lbs.	Lbs.	Tons.
13.....	0.5	July 6.....	1,705	Sept. 3.....	2,335	4,040	4.02
14.....	0.5	July 6.....	1,480	Sept. 3.....	2,200	3,680	3.68

These plots are situated on low-lying, heavy soil. On account of this soil condition and the amount of precipitation received, 1.44 feet, they were not irrigated.

ALSIKE CLOVER.

A plot of alsike clover was sown June, 1915, on spring ploughing, without a nurse crop, at the rate of 8 pounds per acre, a fair stand being obtained. The plants made very good growth, most of them produced heads with well formed seeds, none reached maturity.

FIELD PEAS.

Six plots of one-half acre each were sown May 3, with the Prussian Blue variety at the rate of 3 bushels per acre. Inoculated soil, taken from plots upon which peas were grown the previous year, was applied at the rate of 200 pounds per acre.

Flowering had commenced when the hail storm injured them sufficient to cause second-growth and delay them beyond the possibility of maturing. They were allowed to grow until the first frost, September 11, when they were cut for ensilage.

The peas were weighed green and yielded at the rate of 6 tons 420 pounds per acre, computed from the weight of the crop from a half-acre plot. The vines were well podded and would have produced a heavy yield of grain could they have grown to maturity.

Some experimental plot work was carried on with potatoes and sugar beets, but the results obtained were not of sufficient value to warrant publication.—(EDRORR).

TABLE NO. 5.

Fodder Corn.

Plot No.	IRRIGATION.		Depth of water applied.	Precipitation in feet.	Total Depth of water received.	Yield per plot.	Yield per acre.
	Area.	Date.					
	Acre.		Ft.		Ft.	Lbs.	Tons.
44a.....	.15	Aug. 17...	0.00	1.44	1.44	1,065	3.55
44b.....	.15	" 17...	0.25	1.44	1.69	1,235	4.11
43a.....	.23	" 17...	0.50	1.44	1.94	1,410	3.06
43b.....	.22	" 17...	1.00	1.44	2.44	1,410	3.20

One variety of fodder corn, the North Western Dent, was planted in rows 36 inches apart, at the rate of 25 pounds per acre. The soil was similar in nature and preparation to turnip plots. Planting was done May 20, the seeds germinating quickly. A cold wind, accompanied by low temperatures, occurring on June 8, caused some injury. The hail storm of July 22, shredded the leaves very badly. An average height of 62 inches, with tassels, was obtained, which is very fair, considering soil and climatic conditions. The heavy frost of September 11, which occurred before cutting, reduced the yield considerably. The area planted was divided into four nearly uniform plots, and irrigated on August 14. The crop was cut September 14, and put in silo.

TABLE NO. 6.

Turnips.

Plot No.	IRRIGATION.		Depth of water applied.	Total Precipitation in feet.	Depth of water received.	Yield per plot.	Yield per acre.
	Area.	Date.					
	Acres.		Ft.	Ft.	Ft.	Lbs.	Bush.
46a.....	.19	Aug. 16...	0.00	1.44	1.44	1,650	144.7
46b.....	.18	" 16...	0.25	1.44	1.69	2,140	198.2
45a.....	.35	" 16...	0.50	1.44	1.94	6,790	323.3
45b.....	.38	" 16...	1.00	1.44	2.44	6,185	271.3

The turnips were sown on a very light soil, composed almost entirely of coarse sand crystals, on which a crop of barley had been grown the previous year. It was ploughed 7 inches deep in the spring, packed and harrowed once, and left in this condition until sown. One variety, "MacKenzie's Northwestern," was used, being sown on May 21, at the rate of 5 pounds per acre. This seeding was heavier than necessary, but on account of it being old seed, it was thought advisable to use plenty of it. The area sown was divided into four nearly uniform plots, having regard to character of soil, rather than size. The crop was irrigated once, on August 16. The seed was sown in rows 30 inches apart, and turnips pulled October 23.

GRASSES.

Plot No.	Variety.	Acres.	Yield per plot.	Yield per acre.
			Lbs.	Tons.
49 & 50.....	Timothy.....	1	7,320	3.66
51 & 52.....	Brome.....	1	6,280	3.14
53 & 54.....	Western Rye.....	1	4,090	2.04
55 & 56.....	Mixed Western Rye & Brome.....	1	4,740	2.37

In 1914, four plots of 1 acre each were sown to timothy, brome grass, western rye grass, and mixed western rye and brome grass, allowing one plot to each variety.

They were sown on summer-fallow without a nurse crop. A good yield was obtained. These plots were not irrigated this season until after the crop was removed. After harvest, each plot (containing 1 acre and being made up of two half-acre subdivisions numbered as above, thus, plots 49 and 50 of one-half acre each were used for the acre timothy plot) was divided into four parts, each part receiving a different amount of water.

The lower yields of plots (53, 54) and (55, 56) are due in a measure to the poorer quality of the soil upon which they were sown as compared with plots (49, 50) and (51, 52). The stand was exceptionally heavy.

These plots were irrigated as follows:—

FALL IRRIGATIONS. Plots 49 to 56, Strathmore, Alberta, 1915.

Plot No.	Acres.	Date.	Depth applied in feet.	Crop.
4950a.....	.30	Aug. 9.....	0.00	Timothy.
4950b.....	.29	" 9.....	0.25	
4950c.....	.23	" 9.....	0.50	
4950d.....	.18	" 9.....	1.00	
5152a.....	.25	Aug. 10.....	0.50	Brome.
5152b.....	.25	" 10.....	1.00	
5152c.....	.25	" 10.....	0.25	
5152d.....	.25	" 10.....	0.00	
5354a.....	.25	Aug. 12.....	0.50	Western Rye.
5354b.....	.25	" 12.....	1.00	
5354c.....	.25	" 12.....	0.25	
5354d.....	.25	" 12.....	0.00	
5556a.....	.25	Aug. 11.....	0.25	Mixed Brome and Western Rye.
5556b.....	.25	" 11.....	0.00	
5556c.....	.25	" 11.....	0.50	
5556d.....	.25	" 11.....	1.00	

FIELD Demonstration Plots in the Strathmore and Carseland Districts, 1915.

ALFALFA.

Plot No.	Acres.	Owner.	Location.	Date Sown.	Yield per acre, 1915.	Remarks.
					Tons.	
102.....	13.5	L. M. McKimm	SE. 5-25-24....	1910	4	Very good stand.
112A.....	14	A. S. Downey..	NW. 9-23-25....	1911	2	Fair stand.
105.....	10	W. G. Way.....	NE. 36-24-25....	1912	3.5	Fair stand and yield.
116A.....		G. B. Field.....	NE. 13-22-26....	1912	2.75	Fair stand.
101.....	30	Vander Westen..	NW. 33-24-24....	1912	4	Good stand.
109.....	10	A. Matheson....	SW. 2-24-25....	1913	2	Fair stand. Too much grass.
119.....	10	C. P. Ballard....	NE. 31-23-23....	1914	3.25	Estimated yield, good stand.
122.....	5	H. Harvey.....	E. 1/4 20-24-23....	1914	2	Cut once only, Aug. 20.
101A.....	37	Vander Westen..	NW. 33-24-24....	1915		Fair stand, nurse crop.
102A.....	21	L. M. McKimm	SE. 5-25-24....	1915		Good stand.
111.....		E. E. Zerkle....	SE. 33-23-24....	1915	0.33	Estimated yield, good stand.
114A.....	187	Hans Larsen....	NE. 7-22-25....	1915	1.30	Excellent yield for 1st year.
120.....	15	E. E. Green....	SE. 4-24-24....	1915	0.33	Good Stand.
106.....	2	Tom Crawford	E 1/4 7-24-24....	1915		Hailed out, good recovery.
108.....	1	A. L. Johnson..	NW. 12-24-25....	1915		Clipped once.

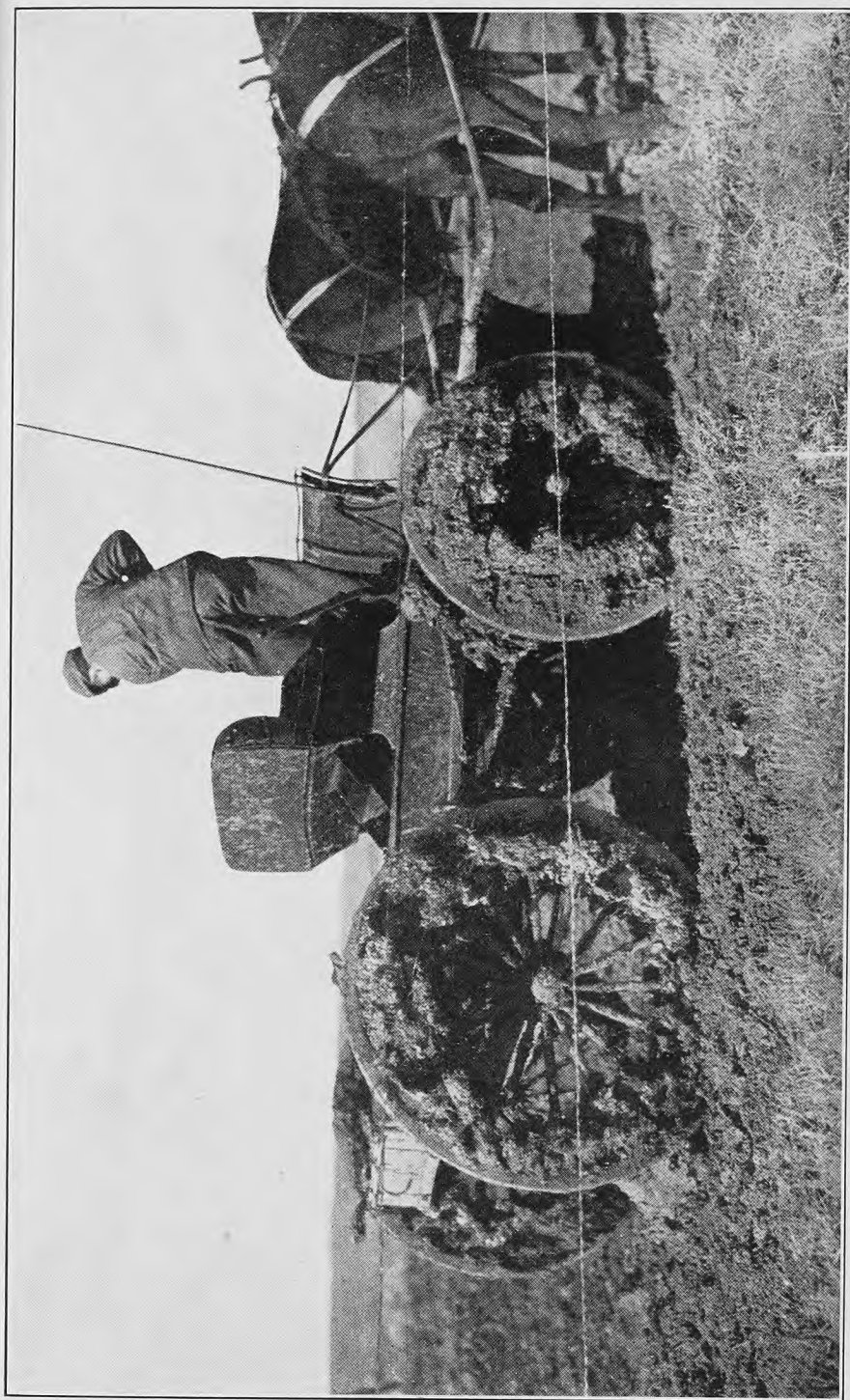
BARLEY.

116.....		G. B. Field.....	NE. 13-22-26....		Bush.	
112.....	5	A. J. Downey...	NW. 9-23-25....		57	Fall ploughed 1914.
					25	Flax 1914. Ploughed May, 1915.

WHEAT.

112A.....		A. J. Downey...	NW. 9-23-25....		40	Summer fallowed 1914.
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None of the above plots were irrigated. The precipitation from April to September was 1.44 feet at Strathmore and 1.64 feet at Carseland. The mean for the two districts was 1.54 feet.



Hydrometrie Engineer in trouble.

Taken by H. W. Rowley.

DUTY OF WATER PLOTS—*Ronalane, Alta.*

ALFALFA.

Plot No.	Area.	Gross Yield Tons.	YIELD PER ACRE-TONS.				WATER APPLIED PER ACRE-DEPTH IN FEET.							Total acre-feet to April incl. (feet).	Rain-fall April to Sept. incl. (feet).	Total acre-feet per acre.
			Total.	1st	2nd	3rd	May 6th.	May 29-31	June 1st.	July 8th.	Aug. 11th.	Aug. 23rd.	Total.			
				crop July 1st.	crop cut 13-14.	crop cut Sept. 28th.										
1.....	1-08	1-79	1-66	0-82	0-84	0-00	.....	0-51	.....	.....	.....	.....	0-51	0-59	0-93	1-34
3.....	1-06	4-29	4-04	1-42	1-42	1-20	.....	0-49	.....	.....	.....	0-52	1-01	1-07	0-93	1-94
4.....	1-11	4-41	3-97	1-35	1-41	1-21	.....	0-69	.....	.....	.....	0-58	1-27	1-41	0-93	2-20
5.....	1-11	4-01	3-60	1-12	1-36	1-12	.....	0-72	.....	.....	.....	0-62	1-34	1-49	0-93	2-27
6.....	1-06	4-10	3-85	1-22	1-43	1-20	.....	0-70	.....	.....	0-65	.....	1-35	1-43	0-93	2-28
7.....	1-06	2-53	2-38	0-57	1-18	0-63	.....	0-49	.....	0-55	0-45	.....	1-49	1-58	0-93	2-42
8.....	1-05	2-31	2-20	0-47	1-04	0-69	.....	0-62	.....	0-40	.....	.....	1-60	1-68	0-93	2-53
9.....	1-07	3-63	3-40	1-04	1-38	0-98	0-73	.....	.....	0-48	0-58	.....	1-79	1-91	0-93	2-72
10.....	1-11	3-75	3-37	1-02	1-39	0-96	0-73	.....	0-42	.....	0-67	.....	1-82	2-02	0-93	2-75
Totals.....	9-71	30-82	.....	9-03	.....	.....	.....	.....	.....	.....	.....	.....	.....	13-18	.....	.....
Average per acre.....	.....	.....	3-17	1-00	1-27	0-90	.....	.....	.....	.....	.....	.....	1-35	.....	.....	2-28

NOTE.—The alfalfa plots were planted in June, 1914, but due to ineffective inoculation as result of planting in dry soil and no early irrigation, the plots did not have a uniform growth in May, 1915; therefore the varied application of water during 1915, cannot be used to indicate any direct comparison of yields in respect to the water applied. Plots 1, 7, and 8 showed similar growth in May, and the use of water during the season for Plots 7 and 8, as compared with 1, show improvement in yield for the latter part of the season.

DUTY OF WATER-PLOTS—*Ronalane, Alta.*—Continued.
WHEAT AND OATS.

Plot No.	Area.	Gross Yield Bus.	Yield Per Acre.	WATER PER ACRE. (time and depth of water).					Total acre-feet.	Rain-fall April to Sept. incl. (feet).	Total acre-feet Per acre.	Remarks.
				June 16.	June 24.	July 8.	July 22.	Total Depth.				
<i>Wheat (Marquis)</i> —												
	11.....	23.08	46.16			0.34		0.34	0.17	0.93	1.27	Fertilized 10 loads manure to acre;
	12.....	21.75	43.50			0.67		0.67	0.34	0.93	1.60	ploughed April 10, 8" depth; harrowed
	13.....	21.84	42.67						0.27	0.93	1.48	April 10, 3 times; seeded April 17, by
	14.....	21.50	43.00		0.55			0.55	0.35	0.93	1.63	drill 1 $\frac{1}{2}$ bush per acre; date up April 28;
	15.....	22.25	44.50		0.70		0.75	1.25	0.62	0.93	2.18	headed July 1; harvested Aug. 17. The
	16.....	22.00	44.00		0.78			0.78	0.39	0.93	1.71	wheat from all irrigated plots mixed
	17.....	23.83	47.67		0.62			0.62	0.31	0.93	1.55	graded No. 3. Dry land wheat on
	18.....	24.67	49.33	0.66		0.68		1.34	0.67	0.93	2.27	summer-fallow yielded 42 bush per acre
Totals.....	4.00	180.92							3.12			graded No. 1.
Averages.....			45.23					0.78			1.71	
<i>Oats (Abundance)</i> —												
	19.....	38.12	76.25		0.52			0.52	0.26	0.93	1.45	Fertilized 10 loads manure to acre;
	20.....	44.25	88.50		0.91			0.91	0.46	0.93	1.84	ploughed April 10, 8" depth; harrowed
	21.....	47.50	95.00		0.76		0.75	1.51	1.13	0.93	2.44	April 10, 3 times; seeded April 17, by
	22.....	59.75	108.33	0.67		0.74	0.66	2.07	1.13	0.93	3.00	drill 2 $\frac{1}{2}$ bush to acre; date up April 26;
	23.....											matured and harvested August 11.
Totals.....	2.05	180.62							2.60			
Averages.....			92.50					1.26			2.19	

DUTY OF WATER-Plots—*Ronalane, Alta.*—Continued.

BARLEY AND PEAS.

Plot No.	Area.	Gross Yield Bush.	Yield per acre.	WATER PER ACRE (time and depth of water).					Total Depth.	Total acre-foot.	Rain-fall April to Sept. incl. (feet.)	Total acre-foot per acre.	Remarks.
				June 16	June 24.	July 8.	July 22.	Aug. 11.					
<i>Barley (Manchury)</i> —													
27.....	.5	24.00	48.00			0.48			0.48	0.24	0.93	1.41	Not fertilized; ploughed April 12, 8 inches deep; harrowed April 12, 3 times; seeded April 19, by drill 2½ bush to acre for irrigated plots and 1½ bush to acre for dry plots. Date up May 1; headed June 25; harvested July 31.
28.....	.5	21.75	43.50			1.00			1.00	0.50	0.93	1.93	
29.....	.5	20.00	40.00			0.83	0.70		1.53	0.76	0.93	2.46	
30.....	.72	35.00	48.60	0.67		0.63	0.66		1.96	0.98	0.93	2.89	
33.....	.60	36.00	60.00	Dry:—(Fallow in 1914).							0.93	0.93	
Totals.....	2.82	136.75								2.48			
Averages.....			48.49						1.12			2.05	
<i>Field Peas (Prussian Blue)</i>													
23.....	.5	10.86	21.72		0.55				0.55	0.27	0.93	1.48	Fertilized 10 loads manure to acre; ploughed April 10, 8 inches deep; harrowed April 10, 3 times seeded April 17, by drill 3 bush per acre for irrigated plots and 1½ bush per acre dry plot, date up April 28, threshed September 6.
24.....	.5	12.83	24.67		0.85				0.85	0.43	0.93	1.78	
25.....	.5	10.63	21.20		0.80				0.80	0.40	0.93	1.73	
26.....	.5	11.66	23.32	0.67		0.65		0.57	1.90	0.85	0.93	2.83	
40.....	.15	3.50	23.33	Dry:—(Fallow in 1914).							0.93	0.93	
Totals.....	2.15	48.95								1.95			
Averages.....			22.76						0.85			1.78	

POTATOES AND SUGAR BEETS.

Plot No.	Area (acres.)	Gross Yield bush.	Yield per acre.	IRRIGATED. (time and depth of Water.)					Total acre- feet.	Rain- fall April to Sept. incl. (feet).	Total acre-feet per acre.	Remarks.	
				June 16.	June 24.	July 22.	Aug. 11.	Aug. 28.					Total.
<i>Potatoes (Gold Coin)—</i>													
31.....	0.35	87.5	250.0		(not irrigated.)					0.93	0.93	Fertilized in 1914; spring ploughed 9" deep; harrowed immedi- ately after ploughing; seeded May 18 by potato planter; date up June 15; cultivated June 20, and July 2; matured and harvested October 15.	
32.....	0.25	98.3	393.2				0.60		0.60	0.93	1.53		
33.....	0.25	102.0	408.0			0.50	0.60		1.10	0.93	2.03		
34.....	0.29	117.2	404.1			0.50	0.60	0.65	1.75	0.93	2.68		
Totals.....	1.14	405.0							1.18				
Averages.....			355.2								2.11		
<i>Sugar Beets (K1, Wanzleben V)—</i>													
35.....	0.21	(tons.) 2.09	9.95		(not irrigated.)					0.93	0.93	Fertilized in 1914; spring ploughed 9" deep; harrowed immedi- ately after ploughing; seeded April 22, by drill 27 lbs. to acre, date up May 8, cultivated June 7, and July 1; thinned June 10; hoed June 25; Harvested-E October 18.	
36.....	0.25	4.00	16.00				0.62		0.62	0.93	1.55		
37.....	0.25	3.45	13.80			0.67	0.62		1.29	0.93	2.22		
38.....	0.28	4.03	14.40			0.67	0.62	0.65	1.94	0.93	2.87		
Totals.....	0.99	13.57											
Averages.....			13.70						1.31		2.24		

FIELD Demonstration Plots in the Gleichen District.

Plot No.	Acres.	Owner.	Location.	Date Sown.	Yield per acre, 1915.	Remarks.
<i>Wheat.</i>					Bush.	
201.....	1	H. Dunn.....	NW. 25-23-23...	1915	31	40% hail damage.
202.....	1	H. Dunn.....	NW. 25-23-23...	1915	31	40% hail damage.
203.....	3.02	J. E. Buckley....	NE. 25-22-23...	1915	62½	Potatoes 1914. S. F. 1913.
206.....	1.12	R. Burne.....	NW. 7-23-22...	1915	45	Summer Fallow in 1914.
210.....	.98	W. H. McPhee....	NE. 24-23-23...	1915	66	Summer Fallow in 1914.
<i>Oats.</i>						
204.....	3	C. W. McMillan...	NE. 10-23-22...	1915	80	Summer-fallow 1914. 20% loss.
209.....	1.13	W. H. McPhee....	NE. 24-23-23...	1915	79	Summer-fallow in 1914.
212.....	1	David McBean....	SE. 31-23-22....	July 9th	75	Broken June 1914.
<i>Alfalfa.</i>						
205.....	1	C. W. McMillan...	NW. 10-23-22...	1915		Sown June 1915. Clipped and left on ground.
					Tons.	
208.....	11	H. W. Lee.....	NE. 36-22-23...	1915	3	Damaged by hail and frost.
<i>Barley.</i>						
211.....	2	F. Daw.....	NW. 32-22-22...	1915		Damaged by storms.

The only plot irrigated was No. 212, which received 0.19 foot.

The precipitation from April to September at Gleichen was 1.24 feet.

DUTY OF WATER TRACTS—Coaldale (near Lethbridge) Alberta, 1915.

Crop.	Acres.	Irr. No.	IRRIGATION.			ACRE-FEET.				Duty of Water.	Pre- cipitation.	Total Depth of Water Received.	Yield per Cutting.	Yield per Acre.	
			Date.		Dura- tion Hrs.	Avr'ge Head C.F.S.	Supplied.	Wasted.	Used.						Per Acre Used.
			Began.	Ended.											
302 Alfalfa.....	30-0	1	July 19	July 22	79	2-43	15-92	2-42	13-50	0-45	1-32	1-77	1-26	3-96 Tons.	
304 Alfalfa.....	34-0	1	Sept. 17	Oct. 1	329	1-29	34-98	0-00	34-98	1-03	1-32	2-35	1-88	3-96 Tons.	
315 Alfalfa.....	50-0	1	May 7	May 19	214	2-48	43-90	33-81	10-11	0-20	1-32	1-52	0-54	4-84	
314a Alfalfa.....	8-5	1	May 27	May 28	20	2-45	3-04	0-11	2-93	0-35	1-32	1-67	1-24	2-04	
314 Alfalfa.....	35-1	1	May 26	June 2	83	3-70	25-40	4-80	20-60	0-59	1-32	1-91	1-41	3-21	
314b Alfalfa.....	7-3	1	May 28	May 29	15	3-62	4-48	0-96	3-52	0-48	1-32	2-03	1-16	2-60	
312 Alfalfa.....	50-0	2	Aug. 26	Aug. 27	32	0-65	1-73	0-06	1-67	0-23	1-32	2-03	1-35	3-14	
310 Alfalfa.....	19-7	2	May 20	May 28	139	2-31	30-30	7-30	23-00	0-46	1-32	2-16	1-31	1-91	
306 Alfalfa.....	43-2	3	June 16	Aug. 25	123	2-25	22-84	3-56	19-28	0-38	1-32	2-16	0-60	1-91	
305 Alfalfa and Timothy.....	23-5	3	May 10	June 21	75	1-62	10-17	0-00	10-17	0-52	1-32	3-52	0-85	1-64	
303 Timothy.....	22-5	2	June 18	June 21	82	2-82	19-14	0-00	19-14	0-69	1-32	1-71	1-82	3-09	
316 Timothy.....	117-0	2	Aug. 14	Aug. 21	163	1-00	13-44	0-00	13-44	0-39	1-32	1-71	1-27	3-09	
307 Oats.....	78-3	1	June 10	June 16	135	2-83	31-53	14-71	16-82	0-39	1-32	1-32	2-20	4-16	
309 Barley.....	23-2	1	May 29	June 5	162	1-70	22-74	6-10	16-64	0-74	1-32	2-72	1-61	4-16	
308 Wheat.....	50-0	2	Sept. 19	Sept. 26	170	1-07	15-03	0-00	15-03	0-66	1-32	2-72	1-50	1-50	
311 Wheat.....	14-9	1	May 22	June 9	626	1-78	92-27	9-58	82-69	0-71	1-32	2-49	1-99	1-99	
317 Wheat.....	25-0	2	Aug. 22	Sept. 21	721	0-90	53-62	0-00	53-62	0-46	1-32	2-49	1-99	1-99	
318 Wheat.....	15-4	1	June 7	June 10	57	2-87	13-50	0-63	12-87	0-86	1-32	2-18	1-99	1-99	
A ver ages for the 18 Tracts.										0-57	1-32	1-89	1-99	45-4 Bus.	

Seeded during 1914.

Seeded 1907 1909

During the past season the same tracts were retained that were used during the season of 1914, with the exception of No. 301, which had to be dropped owing to part of it being turned into pasture. In addition, three more tracts were secured, Nos. 316, 317, and 318.

The preceding table gives a summary of the results of the 1915 work on the Coaldale tracts. Numbers 305, 307, 308, 309, 317 and 318 were not irrigated during 1915. Plot No. 313 was irrigated twice but on account of headgate troubles the water could not be measured. Studying the results of the irrigations applied to tracts 315, 314, 314A, 314B, 310, and 312, all of which are grouped in the Canadian Pacific Railway colony, Coaldale, it is shown that 314, 314A, and 314B produced the greatest yields, with total depths of water received varying from 1.67 to 2.03 acre-feet per acre. Plots 312 and 310 show decreases in yield as the total amount of water received increases. Plot 315, which received the smallest amount of water of this group, shows the smallest yield. The yields of these tracts were to a great extent affected by the different times they were cut and stacked; also a considerable amount of weeds which grew up with the first crop, when cut was separated and burned. In the case of tract 310, a foreign seed was used and the land was not inoculated, which was very noticeable on this season's stand. Both cuttings on tract 312 were late, a considerable amount of weeds was taken from the first cutting and burned. The second cutting yielded only .60 ton per acre. On tract 315 probably one-half the first crop was spoiled by continual wet weather, while on tracts 314, 314A, and 314B there were less weeds, and they were cut and stacked under more favourable conditions.

Tract No. 306 was seeded last year and is situated in a different locality from the C.P.R. colony farms, therefore the results are not comparable.

For the entire eighteen tracts under consideration during 1915 the average total depth of water received by twelve irrigated and six non-irrigated tracts was 1.89 feet.

TABLE showing Averages for Three Years.

Year.	AVERAGE DEPTH OF WATER RECEIVED FORAGE CROPS.			AVERAGE DEPTH OF WATER RECEIVED BY GRAIN CROPS.			AVERAGE FOR ALL TRACTS.		
	Irriga- tion.	Preci- pitation.	Total.	Irriga- tion.	Preci- pitation.	Total.	Irriga- tion.	Preci- pitation.	Total.
1913.....	1.42	0.98	2.40	0.74	0.98	1.72	1.15	0.98	2.13
1914.....	2.11	0.57	2.68	1.37	0.57	1.94	1.84	0.57	2.41
1915.....	0.78	1.32	2.10	0.14	1.32	1.46	0.57	1.32	1.89
Average.....	1.44		2.39	0.75		1.71	1.19		2.14

TABLE showing Average Irrigating Head Used and Acres Irrigated per 24 Hours.

Crop.	Average Depth Applied per Irrigation.	Acreage Irrigated per Day (24 hrs.)	Average Head Used
	Feet.		
Alfalfa (old).....	0.74	3.76	1.86
Alfalfa seeded 1914.....	0.48	6.77	2.34
Timothy.....	0.64	3.98	1.36
Wheat.....	0.86	6.27	2.87
Average for 1915.....	0.68	5.20	2.11
Average for 1914.....	0.86	4.03	2.27
Average for 1913.....	0.72	6.06	2.39
Average for 3 years.....	0.75	5.06	2.26

DISCUSSION OF SUMMARIZED DATA.

The natural precipitation varies greatly from year to year and directly affects the duty of water. In dry years a greater depth of irrigation is required than in wet years. The clearest way to view the matter is to consider both natural precipitation and irrigation water simply as so much depth of water applied to the crops. Then by adding together natural precipitation and irrigation we get the total depth of water applied and thus have a figure which is readily comparable from year to year. In all cases in the discussion hereunder the natural precipitation quoted is for the period April 1 to September 30.

The table below is inserted to show the wide variation in rainfall at the three points noted between 1914 and 1915. The other main element of climate—the mean temperature from April to September—was nearly the same in both years.

	PRECIPITATION.		MEAN TEMPERATURE.	
	1914.	1915.	1914.	1915.
	Feet.	Feet.		
Strathmore.....	0.71	1.44	52.4°F.	52.6°F.
Ronalane.....	0.38	0.93	59.4	57.1
Lethbridge.....	0.57	1.32	55.9	55.4

WHEAT.

During 1915 the wheat at the Strathmore plots was destroyed by hail, but the natural precipitation of 1.44 feet produced bumper crops in that vicinity, and the opinion of the agricultural engineer in the district was that irrigation for this crop was unnecessary. At Ronalane the natural precipitation was 0.93 foot, which produced on summer-fallow 42 bushels. On the plots here the total depths of water applied (including the natural precipitation) ranged from 1.27 feet to 2.27 feet with a range in production from 43 to 49 bushels. The gains by irrigation were hardly sufficient to warrant the expense of irrigation, but the plot which received the most water gave the highest yield and the application of the larger quantities of water did not, on any plot, have any harmful effect on the crop. At Lethbridge the results indicate that the natural precipitation of 1.32 feet was ample without any irrigation.

During 1914 the natural precipitation at Strathmore was 0.71 foot. The greatest depth of irrigation was 0.33 foot. The experiments showed that the natural precipitation produced about 16 bushels and that the addition of this small quantity of water making the total depth 1.04 feet produced about 50 bushels.

The natural precipitations at Lethbridge and Ronalane were, respectively, 0.57 foot and 0.38 foot, and the wheat crops were a failure on dry land.

The experiments for the two years indicate that a total depth of water from 1 foot to 1.5 feet is sufficient for wheat crops.

OATS.

At the Strathmore plots in 1915 the oats were destroyed by hail. At Ronalane the smallest irrigation given was 0.26 foot, making a total depth of 1.45 feet, which produced 76 bushels. As the irrigation was increased there was a constant increase in yield up to the greatest total depth of 3 feet, which produced 108 bushels.

ALFALFA.

At the Strathmore plots during 1915 the natural precipitation of 1.44 feet produced a good crop and irrigation up to a depth of 1 foot, making a total of 2.44 feet. At Ronalane only three plots were comparable, owing to the uneven stand. On these the smallest irrigation was 0.59 foot and the greatest 1.68 feet. The respective total depths of water were 1.34 feet and 2.53 feet, producing a difference of 0.6 ton per acre. At Lethbridge the average total depth of water used for eight tracts was 1.89 feet, varying from 1.52 feet to 2.35 feet.

During 1914 the experimental alfalfa plots were sown at Strathmore and Ronalane but comparative crop results are not available. At Lethbridge, the average total depth of water used for seven tracts, mainly new alfalfa, was 2.45 feet, varying from 1.96 feet to 3.18 feet.

Two old tracts of alfalfa at Lethbridge, each containing about 30 acres, have now been observed for three consecutive years and the results are noted hereunder.

	Year.	Total depth water.	Crop—tons.
Tract 302.....	1913	2.69	4.70
	1914	1.96	4.21
	1915	1.77	3.96
Tract 304.....	1913	2.68	4.40
	1914	2.27	4.57
	1915	2.35	4.84

These two fields have produced very high yields for three consecutive years so that it may be inferred that they received about the proper depth of water each year. The average total depth for the two fields for three years is 2.29 feet.

POTATOES.

At the Strathmore plots during 1915 this crop was diseased and unhealthy so that the dry crop produced only 216 bushels with the natural precipitation of 1.44 feet. A total depth of 1.94 feet did not have any marked effect on the crop, producing only 222 bushels, and the maximum total depth of 2.44 feet produced only 235 bushels, showing no increase over a total depth of 2.10 feet. At Ronalane the natural precipitation of 0.93 foot produced 250 bushels, while a total depth of 1.53 feet produced 393 bushels, the irrigation having a very marked effect. Additional irrigation giving a total depth of 2.03 feet produced only a small increase up to 408 bushels, and a total depth of 2.44 feet showed no further gain.

During 1914 at Strathmore when the natural precipitation was only 0.71 foot the irrigation water produced a very marked increase of yield up to a total depth of 1.11 feet, which was the greatest amount applied. At Ronalane the plots were all irrigated very heavily and all the yields were very small. The smallest depth of irrigation making a total depth of 2.88 feet gave generally the best results, but it is quite possible that a smaller irrigation giving a total of about 2 feet would have produced much better results.

FIELD PEAS.

At the Strathmore plots in 1915 the field peas were badly hailed, while in flower, which caused a second growth and rendered the crop of no value for experimental purposes. The crop was cut and used for ensilage. At Ronalane the natural precipitation of 0.93 foot produced 23.3 bushels on summer-fallow. Irrigation was used in varying depths, the greatest total depth being 2.83 feet. The irrigation did not have any marked effect on the yield, the highest from any plot being 24.7 bushels.

During 1914 the same variety of peas were grown at Strathmore with inoculation. The natural precipitation of 0.71 foot produced 28 bushels, while a total depth of 1.11 feet produced a very marked increase up to 40 bushels.

BARLEY.

During 1915 at the Strathmore plots the barley was spoiled by hail. At Ronalane the natural precipitation of 0.93 foot produced 60 bushels on summer-fallow. Varying depths of irrigation were applied up to a total depth of 2.89 feet but the irrigated plots produced less than the dry plots, varying from 40 to 48 bushels.

SUGAR BEETS.

During 1915 at the Strathmore plots the stand obtained was poor and uneven, so that it is difficult to make comparison, but the results indicate that the natural precipitation of 1.44 feet produced as good a yield as any of the irrigated plots. At Ronalane the natural precipitation of 0.93 foot produced 9.95 tons, while one irrigation bringing the total depth up to 1.55 feet produced 16.0 tons. Increased irrigation up to a total depth of 2.87 feet produced 14.0 tons only.

STAFF EMPLOYED.

The work was all carried out under the direct supervision of the late Mr. G. I. Walters, whose work had proved so efficient. His sudden and much regretted demise in January last was a great loss to the staff. Since Mr. Walter's death the supervision of the work has been carried on by Mr. W. H. Snelson, who was in the Gleichen district during 1915. Mr. Chas. Giffen had charge of the plots at Strathmore and Mr. J. E. Degnan had charge at Lethbridge. The plots at Ronalane were under the charge of Mr. Hansen who is employed by the Southern Alberta Land Company.

PREFACE TO REPORTS FOLLOWING.

The Commissioner of Irrigation has in the preceding pages given in very brief form an outline of the several branches of the work carried on during the year and has noted some of the more interesting details so as to indicate the scope of the work.

In the following pages will be found a summary report by the commissioner respecting experimental work carried on under his direction for the purpose of determining the proper duty of water, and reports on crops grown under irrigation in certain districts where an attempt has been made to demonstrate the value of irrigation, also brief reports from the officers in charge of the more important divisions of work in connection with irrigation development and surveys.

The data gathered in connection with the work of stream measurement for 1915 will be published in a report entitled "Hydrometric Surveys, 1915."

BENCH-MARKS.

REVISED LIST OF PERMANENT BENCH-MARKS ESTABLISHED BY THE IRRIGATION BRANCH,
WEST OF THE FOURTH MERIDIAN.

A revised list of all the permanent bench-marks which have been established west of the fourth meridian is submitted with this report. The list contains thirty-four permanent bench-marks which were set during 1915.

This list contains seventeen corrections to old bench elevations on account of the equation between the original Irrigation Branch datum and mean sea level datum having been corrected; also six corrections to old bench-mark elevations on account of errors discovered in original elevations as determined by further work done during 1915.

BENCH-MARKS.

Revised List of Permanent Bench-marks Established by the Irrigation Branch, West of the Fourth Meridian.

Number.	LOCATION.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
451.....	2	1	W. of 4th.	NE. Cor.....	2977-91	34-54	3012-45	Permanent Gov't. B.M.
452.....	3	1	"	SW. Cor.....	3006-03	34-54	3040-57	"
453.....	3	1	"	NW. $\frac{1}{4}$ Sec. 36.	3008-38	34-54	3042-92	"
454.....	3	1	"	NE. Cor.....	3038-57	34-54	3073-11	"
455.....	4	1	"	NE. Cor.....	3311-65	34-54	3346-19	"
456.....	5	1	"	NE. Cor. Sec. 24.	3445-48	34-54	3480-02	"
457.....	5	1	"	NE. Cor.....	3580-59	34-54	3615-13	"
458.....	8	1	"	NE. Cor. Sec. 24.	4436-79	34-54	4471-33	"
	8	1	"	NE. Cor.....	3774-67	34-54	3809-21	Top of Township Post.
459.....	9	1	"	NE. Cor.....	3084-01	34-54	3118-55	"
608.....	11	1	"	NE. Cor.....	2410-07	34-54	2444-61	Permanent Gov't. B.M.
	11	1	"	South Bank of Mackay ck. N. Traffic bridge Sec. 26.			2443-73	Hydrometric.
460.....	3	2	"	NE. Cor.....	3203-97	34-54	3238-51	"
461.....	3	3	"	SW. Cor.....	2955-47	34-54	2990-01	"
462.....	4	2	"	NE. Cor.....	3339-98	34-54	3374-52	"
463.....	4	2	"	NE. Cor.....	3581-07	34-54	3615-61	"
609.....	11	2	"	South bank Ross ck. Traffic bridge in sec. 31.				Hydrometric.
464.....	3	3	"	NE. Cor.....	3104-23	34-54	3198-77	"
465.....	4	4	"	NE. Cor.....	3538-09	34-54	3572-63	"
466.....	5	3	"	NE. Cor.....	3524-68	34-54	3559-22	Permanent Gov't. B.M.
610.....	12	5	"	West Bank Bullshead ck. near Traffic bridge in sec. 16.			2305-53	Hydrometric.
611.....	1	5	"	620 Ft. East of NE. Cor. sec. 1.	2707-72	13-29	2694-43*	"
612.....	1	5	"	2,300 Ft. N. 68° 30' E. of NE. Cor. Sec. 31	2726-43	13-29	2713-14*	"
613.....	3	5	"	NE. Cor. Sec. 36.	3187-16	31-96	3219-12*	"
614.....	1	3	"	120 Ft. North of NE. Cor. Sec. 13.	2770-71	31-96	2757-42*	"
615.....	2	2	"	1,900 Ft. North of NE. Cor. Sec. 12.	2790-53	31-96	2777-24*	"
467.....	3	7	"	NE. Cor.....	2801-53	31-96	2833-49	"
	3	7	"	SE. Cor.....	3210-03	31-96	3241-99	Top of Iron pin.
468.....	4	4	"	NE. Cor.....	2814-09	31-96	2846-05	Permanent Gov't. B.M.
616.....	2	8	"	800 Ft. South NE. Cor. Sec. 13.	2831-65	13-29	2818-35*	"
617.....	2	2	"	SW. $\frac{1}{4}$ Sec. 21	2850-83	13-29	2837-54*	"
469.....	3	8	"	NE. Cor.....	2944-20	31-96	2970-16	"
470.....	5	8	"	NE. Cor.....	2834-73	31-96	2856-09	"

471	6	"	NE. Cor.	2702.89	31-96	2734.85	"
618	2	"	2,200 Ft. North of NE. Cor. Sec. 13.	2863.00	13-29	2849.71*	"
472	3	"	SE. Cor.	2844.11	31-96	2876.07	"
473	3	"	NE. Cor.	2937.92	31-96	2969.88	"
474	4	"	NE. Cor.	2848.75	31-96	2880.71	"
475	5	"	NE. Cor.	2827.31	31-96	2859.27	"
476	6	"	NE. Cor.	2772.23	31-96	2804.10	"
619	2	"	990 Ft. South of NE. Cor. Sec. 25	2891.87	13-29	2878.58*	"
477	3	"	NE. Cor.	3032.59	31-96	3064.55	"
478	3	"	SE. Cor.	2941.68	31-96	2973.64	"
479	4	"	NE. Cor.	2976.75	31-96	3008.71	"
480	5	"	NE. Cor.	2864.65	31-96	2896.61	"
481	6	"	NE. Cor.	2756.95	31-96	2788.91	"
620	2	"	2,242 Ft. N. of NE. Cor. Sec. 13	2917.13	13-29	2903.84*	"
482	3	"	NE. Cor.	3049.14	31-96	3081.10	"
483	3	"	SE. Cor.	2949.00	31-96	2980.96	Top of Iron pin.
484	4	"	NE. Cor.	3005.00	31-96	3036.96	Permanent Gov't. B.M.
485	5	"	NE. Cor.	2977.09	31-96	3009.05	"
486	6	"	NE. Cor.	2821.71	31-96	2853.67	Top of Iron pin.
487	7	"	NE. Cor.	2658.48	31-96	2690.44	Permanent Gov't. B.M.
488	8	"	NE. Cor.	2714.82	31-96	2746.78	"
489	9	"	NE. Cor.	2713.60	31-96	2745.56†	"
490	2	"	900 Ft. North of NE. Cor. Sec. 12	2947.26	13-29	2933.97*	"
491	3	"	SE. Cor.	3160.62	31-96	3192.58	Top of Iron pin.
492	3	"	NE. Cor.	3162.73	31-96	3194.69	"
493	4	"	NE. Cor.	3050.02	31-96	3081.98	Permanent Gov't. B.M.
494	5	"	NE. Cor.	2915.90	31-96	2947.86	"
495	6	"	NE. Cor.	2839.95	31-96	2871.91	"
621	7	"	NE. Cor.	2734.12	31-96	2766.08	"
622	8	"	NE. Cor.	2656.47	31-96	2688.43	"
623	9	"	NE. Cor.	2599.48	31-96	2631.44	"
624	10	"	NE. Cor.	2518.10	31-96	2550.06	"
625	1	"	500 Ft. South of NE. Cor. Sec. 36	2990.40	13-29	2977.11*	"
496	2	"	NE. Cor.	3096.16	13-29	3052.87*	Top of Iron post.
497	3	"	SE. Cor.	3010.59	31-96	3042.55	Permanent Gov't. B.M.
498	3	"	NE. Cor.	3062.58	31-96	3094.54	"
499	4	"	NE. Cor.	3033.42	31-96	3065.38	"
500	5	"	NE. Cor.	3021.93	31-96	3053.89	"
501	6	"	NE. Cor.	2627.03	31-96	2658.99	"
502	7	"	NE. Cor.	2749.23	31-96	2781.19	"
503	8	"	NE. Cor.	2681.34	31-96	2713.30	"
504	9	"	NE. Cor.	2652.27	31-96	2684.23	"
505	10	"	NE. Cor.	2617.62	31-96	2649.58	"
506	2	"	3,220 Ft. North of NE. Cor. Sec. 1	3046.11	13-29	3032.82*	"
507	3	"	NE. Cor.	3005.70	31-96	3037.66	"
508	3	"	SE. Cor.	3070.84	31-96	3102.80	Top of Iron pin.
509	4	"	NE. Cor.	2984.62	31-96	3016.58	Permanent Gov't. B.M.
510	5	"	NE. Cor.	3008.73	31-96	3040.69	"
511	6	"	NE. Cor.	2889.11	31-96	2921.07	"
512	7	"	NE. Cor.	2821.94	31-96	2853.90†	"
513	8	"	NE. Cor.	2736.15	31-96	2768.11	"

BENCH-MARKS—Continued.

Revised List of Permanent Bench-marks Established by the Irrigation Branch, West of the Fourth Meridian.

Number.	LOCATION.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Remarks.							
	Township.	Range.	Meridian.					
507.....	9	14	W. of 4th.	NE. Cor.....	2614-81	31-96	2646-77	"
508.....	10	14	"	NE. Cor.....	2506-59	31-96	2538-55	"
627.....	2	15	"	NE. Cor. Sec. 1.....	3201-60	13-29	3188-31*	"
509.....	3	15	"	SE. Cor.....	3040-54	31-96	3072-50	"
510.....	3	15	"	NE. Cor.....	3037-38	31-96	3069-34	"
511.....	4	15	"	NE. Cor.....	3053-75	31-96	3085-71	"
512.....	5	15	"	NE. Cor.....	3025-86	31-96	3057-82	"
513.....	6	15	"	NE. Cor.....	2973-19	31-96	3005-15	"
514.....	7	15	"	NE. Cor.....	2881-65	31-96	2913-51	"
515.....	8	15	"	NE. Cor.....	2832-03	31-96	2863-99†	"
516.....	9	15	"	NE. Cor.....	2681-72	31-96	2713-68	"
517.....	10	15	"	NE. Cor.....	2547-96	31-96	2579-92	"
628.....	2	16	"	NE. Cor. Sec. 1.....	3382-32	13-29	3369-03*	Permanent Gov't. B.M.
629.....	2	16	"	N. Bank Milk R. N. Railway Sec. 21.....	3380-46	31-96	3412-42	Hydrometric.
518.....	3	16	"	NE. Cor.....	3191-24	31-96	3223-20	"
519.....	3	16	"	SE. Cor.....	3415-37	31-96	3447-33	"
520.....	4	16	"	NE. Cor.....	3093-43	31-96	3125-39	"
521.....	5	16	"	NE. Cor.....	2888-67	31-96	2920-63	"
522.....	6	16	"	NE. Cor.....	3052-71	31-96	3084-67	"
523.....	7	16	"	NE. Cor.....	2915-10	31-96	2947-06	"
524.....	8	16	"	NE. Cor.....	2686-55	31-96	2718-51	Top of Iron pin.
525.....	9	16	"	NE. Cor.....	2625-11	31-96	2657-07	Permanent Gov't. B.M.
526.....	10	16	"	NE. Cor.....	2528-24	31-96	2560-20	"
630.....	11	16	"	NE. Cor. Sec. 34.....	2405-32	31-96	2437-28	"
527.....	2	17	"	1,870 Ft. North of NE. Cor. Sec. 24.....	3460-38	13-29	3447-09*	"
528.....	3	17	"	NE. Cor.....	3324-90	31-96	3356-86	"
529.....	3	17	"	NE. Cor. Sec. 1.....	3447-94	31-96	3479-90	"
530.....	4	17	"	NE. Cor.....	3215-00	31-96	3246-96	"
531.....	5	17	"	NE. Cor.....	3087-46	31-96	3119-42	"
532.....	6	17	"	NE. Cor.....	3084-02	31-96	3115-98	"
533.....	7	17	"	NE. Cor.....	2961-85	31-96	2993-81	"
535.....	8	17	"	NE. Cor.....	2745-60	31-96	2777-56	"
536.....	9	17	"	NE. Cor.....	2635-82	31-96	2667-78	"
537.....	10	17	"	NE. Cor.....	2429-63	31-96	2461-59	"
538.....	11	17	"	SE. Cor.....	2585-27	11-02	2596-29	"
539.....	11	17	"	NE. Cor.....	2582-31	11-02	2593-33	"

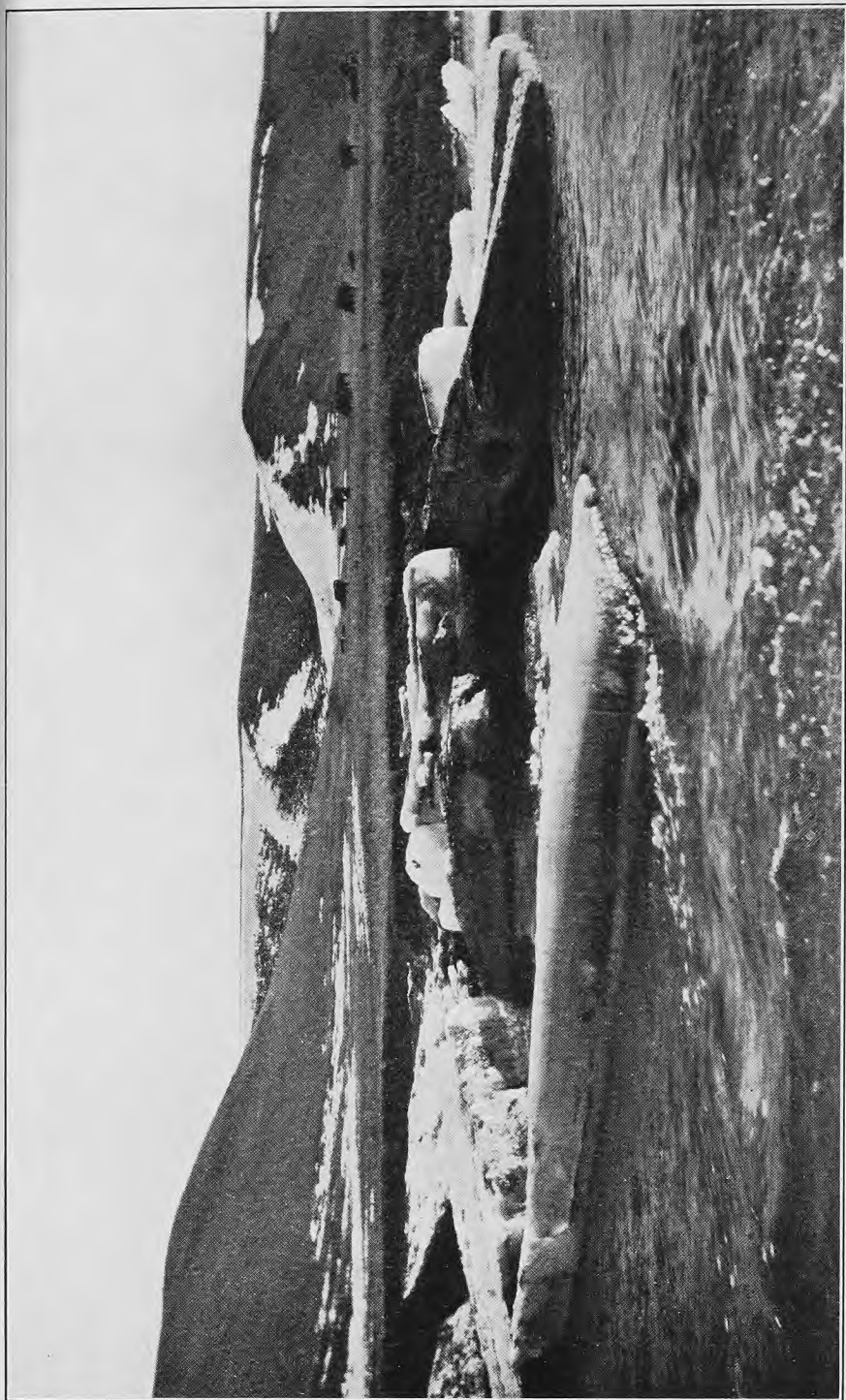
539	12	17	NE. Cor.	2596-03	2596-05	"
540	13	17	NE. Cor.	2603-10	2614-12	"
541	2	18	NE. Cor. Sec. 24	3517-89	3501-68*	"
	3	18	NE. Cor.	3444-44	3470-40	"
	4	18	NE. Cor.	3176-03	3196	"
	5	18	NE. Cor.	3127-23	3159-19†	"
	8	18	NE. Cor.	2879-72	2911-68	"
	9	18	NE. Cor.	2667-92	2699-88	"
	10	18	NE. Cor.	2683-34	2694-36	"
	11	18	NE. Cor.	2929-64	2940-66	"
	11	18	NE. Cor.	2673-42	2684-44	"
	12	18	NE. Cor.	2570-74	2581-76	"
	13	18	NE. Cor.	2611-91	2622-93	"
	14	18	NE. Cor.	2576-29	2587-31	"
	15	18	NE. Cor.	3579-10	3565-81*	"
	2	19	1,716 Ft. North of NE. Cor. Sec. 13	3205-28	3237-24†	"
	5	19	NE. Cor. Sec. 30	3035-21	3067-17	"
	5	19	NE. Cor.	2859-91	2891-87	"
	7	19	NE. Cor.	2738-88	2749-90	"
	8	19	NE. Cor.	2682-90	2693-92	"
	11	19	NE. Cor.	2654-47	2665-49	"
	12	19	NE. Cor.	2604-04	2615-06	"
	13	19	NE. Cor.	2658-96	2669-98	"
	14	19	NE. Cor.	3679-39	3680-41	"
	15	19	NE. Cor.	3194-42	3226-38	"
	16	19	NE. Cor.	3303-56	3235-52	"
	2	20	970 Ft. South NE. Cor. Sec. 12	2779-88	2790-90	"
	5	20	NE. $\frac{1}{2}$ Sec. 30	2784-15	2795-17	"
	5	20	NE. Cor. Sec. 11	2769-48	2780-50	"
	10	20	NE. Cor. Sec. 35	2707-74	2718-76	"
	11	20	NE. Cor.	2686-86	2697-88	"
	12	20	NE. Cor.	2788-11	2799-12	"
	13	20	NE. Cor.	2790-75	2801-77	"
	14	20	NE. Cor.	3838-27	3824-98*	"
	15	20	NE. Cor.	3650-12	3682-08†	"
	16	20	NE. Cor.	2958-78	2993-43†	"
	2	21	940 Ft. South NE. Cor. Sec. 13	2907-01	2918-03	"
	4	21	NE. Cor. Sec. 33	2869-60	2880-62	"
	21	21	NE. Cor. old Lethbridge Court House, Sec. 31	3975-66	3962-37*	"
	21	21	NE. Cor. Sec. 35	4036-64	4023-25†	"
	2	22	NE. Cor. Sec. 36	3699-57	3731-55†	"
	3	22	NE. Cor. Sec. 12	3993-66	3425-62	"
	3	22	NE. Cor. Sec. 35	3012-61	3023-63	"
	10	22	NE. $\frac{1}{2}$ Sec. 11	4084-91	4116-87†	"
	1	23	380 Ft. S. 16° W. NE. Cor. Sec. 24	4091-24	4077-95*	"
	1	23	3,082 Ft. W. of SE. Cor. Sec. 3	4187-14	4173-85*	"
	1	23	NE. Cor. Sec. 7	4096-48	4128-44	"
	2	23	NE. Cor.	3814-73	3846-69†	"
	3	23	NE. Cor. Sec. 36	3972-88	4004-84	"
	3	23	NE. Cor. Sec. 17			"
571	8	21				"
569	10	21	NE. Cor. Sec. 35			"
570	11	21	NE. Cor. Sec. 36			"
633	1	22	1,030 Ft. South of NE. Cor. 36			"
634	1	22	1,500 Ft. East of NE. Cor. 32			"
572	3	22	NE. Cor. Sec. 36			"
573	3	22	NE. Cor. Sec. 12			"
574	10	22	NE. Cor. Sec. 35			"
575	1	23	NE. $\frac{1}{2}$ Sec. 11			"
635	1	23	380 Ft. S. 16° W. NE. Cor. Sec. 24			"
485	1	23	3,082 Ft. W. of SE. Cor. Sec. 3			"
576	2	23	NE. Cor. Sec. 7			"
577	3	23	NE. Cor.			"
578	3	23	NE. Cor. Sec. 36			"

Hydrometric.

BENCH-MARKS—*Concluded.*

Revised List of Permanent Bench-marks Established by the Irrigation Branch, West of the Fourth Meridian.

Number.	LOCATION.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
579.....	9	23	W. of 4th.	NE. Cor.	3055.16	11-02	3066.18	"
580.....	10	23	"	NE. Cor. Sec. 35.....	3203.92	11-02	3214.94	"
581.....	11	23	"	NE. Cor.	3131.01	11-02	3142.03	"
582.....	12	23	"	NE. Cor.	3261.45	11-02	3272.47	"
583.....	1	24	"	SW. Cor. Sec. 3.....	4204.86	31-96	4236.82†	"
584.....	2	24	"	Sec. 21, A. R. & I. Flume, Rolph Creek.	3812.35	31-96	3844.31*	"
585.....	10	24	"	NE. Cor. Sec. 35.....	3924.67	11-02	3956.63†	"
586.....	11	24	"	NE. Cor.	3134.22	11-02	3145.24	"
587.....	12	24	"	NE. Cor.	3121.78	11-02	3132.80	"
588.....	1	25	"	NE. Cor. Sec. 1.....	4192.19	31-96	4224.15†	"
589.....	1	25	"	S. 1/4 Md., Sec. 5.....	4137.27	31-96	4169.23	"
590.....	1	25	"	Sec. 25, Gauging Sta., St. Mary R.	3872.28	31-96	3904.24*	"
591.....	1	25	"	NE. Cor. Sec. 36.....	3937.84	31-96	3969.80†	Hydrometric.
592.....	1	25	"	NE. Cor. Sec. 9.....	4018.82	31-96	4050.78†	Old B.-M. No. 90, established 1895.
593.....	1	25	"	E. 1/4 Sec. 8.....	4054.28	31-96	4086.24	Top of iron post.
594.....	1	25	"	Sill of headgate, A. R. & I. Co's canal,	3853.80	31-96	3885.76†	Permanent Gov't. B.-M.
595.....	2	25	"	Kimball, Alta.				
637.....	2	25	"	E. 1/4 Cor. Sec. 15.....	3879.87	31-96	3911.83*	Permanent Gov't. B.-M.
638.....	3	25	"	Sec. 9, on Lee creek, at Cardston.	3686.76	31-96	3718.72*	"
591.....	10	25	"	NE. Cor. Sec. 35.....	3142.95	11-02	3153.97	"
592.....	11	25	"	NE. Cor.	3169.19	11-02	3180.21	"
593.....	12	25	"	NE. Cor.	3179.84	11-02	3190.86	"
594.....	1	26	"	275 Ft. East of the NE. Cor. Sec. 10.....	4332.66	31-96	4364.62†	"
595.....	2	26	"	E. 1/4 Cor. Sec. 6.....	4334.36	31-96	4426.32†	"
639.....	3	26	"	NE. Cor. Sec. 8.....	3961.97	31-96	3993.93*	"
640.....	2	26	"	NE. Cor. Sec. 36.....	3979.35	31-96	4011.31*	"
641.....	2	26	"	Sec. 27, gauging sta., Lee creek	3906.89	31-96	3938.85*	"
596.....	10	26	"	NE. Cor. Sec. 35.....	3214.80	11-02	3225.82	"
597.....	11	26	"	NE. Cor.	3229.67	11-02	3240.69	"
598.....	12	26	"	NE. Cor.	3229.66	11-02	3231.68	"
599.....	13	26	"	NE. Cor.	3182.60	11-02	3193.62	"
600.....	2	27	"	NE. Cor. Sec. 5.....	4372.65	31-96	4404.61†	"
601.....	9	27	"	NE. Cor. Sec. 10.....	3207.75	11-02	3218.77	"
602.....	10	27	"	On Willow creek, 2.418 Ft. N. 61° 57' W. from NE. Cor.	3249.36	11-02	3269.38	"



Ice Jam, North Branch of Milk River.

Taken by V. A. Newhall, 20-2-16.

603.....	2	28	"	1,912 Ft. South of E. $\frac{1}{4}$ Cor., Sec. 12,	4396-87	31-96	4498-83 [†]	"	"	"
604.....	2	28	"	At Cable sta. on Belly river at West's ranch, NE. Sec. 5.	4356-74	31-96	4388-70 [†]	"	"	, Hydrometric.
642.....	3	28	"	E. $\frac{1}{4}$ Cor. Sec. 34.....	4039-88	31-96	4071-84*	"	"	"
643.....	3	28	"	NE. Cor. Sec. 12.....	4024-24	31-96	4056-20*	"	"	"
606.....			"	On Oldman river, below mouth of Beaver creek 1,500 Ft.	3284-56	31-96	3295-58	"	"	"
607.....			"	Oldman river, 1 mile below Indian Mission.	3300-55	31-96	3311-57	"	"	"
605.....	2	29	"	Waterton river cable sta. NE. Sec. 8....	4162-56	31-96	4194-52 [‡]	"	"	, Hydrometric.

NOTE.—All Bench-marks shewn with a number from 400 up are the type of Permanent Iron Bench-marks adopted by the Irrigation Branch, Department of the Interior 1911 the remainder are permanent Bench-marks of a different type.

[†]Bench-marks where equation has been corrected.

[‡]Bench-marks where elevation has been corrected.

*Bench-marks established 1915.

EVAPORATION FROM A FREE-WATER SURFACE.

Following the discussion which was submitted in last year's report on absorpt losses from reservoirs it is interesting to note the data gained this year at Strathmore and Lethbridge showing the evaporation from a free water surface. Galvanized tanks 4 feet in diameter and 18 inches deep were set in the ground with the top from 1 to 2 feet above the ground. Careful account was kept of the amount of water which was daily added or taken out to keep the surface at a point fixed within the tank approximately the same elevation as the surrounding ground.

EVAPORATION from free water surface. Strathmore, Alta., 1915.

Month.	Total Evaporation in Inches.	Mean Daily Evaporation in Inches.
April.....	4.22	.141
May.....	4.73	.153
June.....	4.33	.143
July.....	6.47	.209
August.....	4.25	.137
September.....	2.27	.076
October.....	1.78	.059
Total.....	28.05	

EVAPORATION from free water surface. Coaldale, Alta., 1915.

Month.	Total Evaporation in Inches.	Mean Daily Evaporation in inches.
April.....	5.68	.189
May.....	4.28	.138
June.....	2.26	.075
July.....	4.38	.141
August.....	4.97	.160
September.....	2.93	.098
Total.....	24.50	

CONSUMPTION OF WATER FOR MUNICIPAL SUPPLY.

During the past year an attempt has been made to obtain more definite and complete records than are at present available of the actual quantities of water being used for municipal purposes in the larger towns and cities in the provinces of Alberta and Saskatchewan.

The objects in view are: (1) to facilitate the efforts of this department in determining the basis of quantity per capita in the issuing of licenses for "municipal purposes" and, (2) to obtain from official returns prepared on standard forms, an analysis of the municipal consumption for the special benefit of public bodies, municipal engineers, etc.

Twelve months' records have now been obtained for many of the important towns and cities and these have been summarized and analysed with a view to showing the relationship between the quantities which have been used per head, per day for domestic, industrial and other public purposes.

The Branch is indebted to the city engineers, waterworks superintendents and other officials of the respective cities and towns for the data which have been compiled for publication. It is hoped that the compiled data will prove of interest to the officials, and that we may be able to continue and extend the compilation in future years.

Month.	REGINA. Population 35,000.				MOOSEJAW. Population 25,000.				SASKATOON. Population 25,000.				NORTH BATTLEFORD. Population 5,750.			
	Per head for				Per head for				Per head for				Per head for			
	Total Con- sumption.	domestic purposes.	other purposes.	Industrial purposes.	all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Industrial purposes.	all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Industrial purposes.	all purposes.	Total Con- sumption.
January.....	2,283,286	56.0	.....	9.0	65	607,581	.....	.....	.....	24	1,044,226	24.0	0.3	12.6	42	83,612
February.....	2,129,122	51.0	.....	10.0	61	485,036	.....	.....	.....	19	1,020,786	24.0	0.3	12.6	41	84,557
March.....	2,154,303	51.0	.....	10.0	61	649,677	.....	.....	.....	26	1,002,161	24.0	0.3	12.6	41	111,412
April.....	2,035,916	53.8	0.2	6.0	60	752,697	.....	.....	.....	30	1,020,700	22.0	4.8	11.8	42	95,900
May.....	2,073,419	56.0	0.2	2.8	59	758,615	.....	.....	.....	30	1,050,807	22.0	4.8	11.8	42	82,977
June.....	1,940,228	52.0	0.2	2.8	55	762,033	.....	.....	.....	30	1,121,534	22.0	4.8	11.8	42	85,563
July.....	2,051,637	53.3	0.4	5.3	59	764,419	.....	.....	.....	31	1,355,900	20.4	2.8	14.6	54	74,951
August.....	2,151,564	52.2	0.4	8.4	61	788,838	.....	.....	.....	31	1,263,290	20.4	2.8	14.6	50	85,303
September.....	2,143,160	52.2	0.2	8.6	61	746,067	24.5	5.4	.....	30	1,148,166	.....	.....	.....	46	78,556
October.....	2,449,031	58.9	0.2	10.9	70	730,774	25.2	4.0	.....	29	1,198,742	.....	.....	.....	48	85,470
November.....	2,452,790	61.5	.....	8.5	68	791,233	.....	.....	.....	32	1,227,677	19.9	0.9	16.6	49	83,816
December.....	2,376,162	60.1	.....	7.9	68	788,968	.....	.....	.....	31	1,220,677	21.6	2.2	13.9	49	69,919
Average for year.....	2,192,135	55.0	0.1	7.5	63	718,825	24.1	4.6	.....	29	1,139,502	21.6	2.2	13.9	46	85,170

NOTE.—Respecting the city of Saskatoon there is an average consumption of 7.9 Imperial gallons per head per day unaccounted for.

NOTE.—There is considerable loss due to leakage in the city of North Battleford, being at an average for the year of 4.2 Imperial gallons per head per day.

CITIES AND TOWNS in the Province of Alberta.—Daily record of water consumption in Imperial gallons.

Month.	TABER.					BASSANO.					ATHABASKA.					CLARESHOLM.				
	Population 2,500.					Population 1,600.					Population 950.					Population 900.				
	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.
January.....	12,437	5.0	.....	.....	35.1	65,706	6.0	.....	.....	15.0	18,065	15.0	.....	.....	15.0	28,516	26.3	5.4	.....	31.7
February.....	16,011	6.4	.....	.....	41.0	76,575	6.4	0.4	.....	18.0	21,640	18.0	.....	.....	18.0	50,535	49.8	6.3	.....	56.1
March.....	.....	.....	.....	.....	47.6	84,261	5.1	.....	.....	22.9	27,338	22.9	.....	.....	22.9	49,548	49.3	5.7	.....	55.0
April.....	.....	.....	.....	.....	49.2	91,337	7.9	.....	.....	20.8	24,958	20.8	.....	.....	20.8	42,566	41.4	5.9	.....	47.3
May.....	.....	.....	.....	.....	67.0	116,884	6.0	.....	.....	13.9	16,693	13.9	.....	.....	13.9	39,323	38.0	5.7	.....	43.7
June.....	.....	.....	.....	.....	83.9	144,397	6.3	.....	.....	4.6	5,553	4.6	.....	.....	4.6	27,333	26.0	4.4	.....	30.4
July.....	.....	.....	.....	.....	77.9	134,371	6.1	.....	.....	11.4	9,112	11.4	.....	.....	11.4	24,581	23.0	4.3	.....	27.3
August.....	.....	.....	.....	.....	69.7	124,713	8.2	.....	.....	9.4	7,524	9.4	.....	.....	9.4	32,419	31.0	5.0	.....	36.0
September.....	.....	.....	.....	.....	62.0	108,187	5.6	.....	.....	12.4	9,883	12.4	.....	.....	12.4	31,700	29.3	5.9	.....	35.2
October.....	.....	.....	.....	.....	66.7	117,130	6.5	.....	.....	15.9	9,548	15.9	.....	.....	15.9	39,000	37.6	5.7	.....	43.3
November.....	.....	.....	.....	.....	57.7	103,066	6.7	.....	.....	13.7	8,217	13.7	.....	.....	13.7	50,566	47.3	8.9	.....	56.2
December.....	.....	.....	.....	.....	64.3	114,839	7.5	.....	.....	13.7	8,242	13.7	.....	.....	13.7	76,612	49.3	35.8	.....	85.1
Average for year.....	14,224	5.7	.....	.....	60.2	106,789	6.5	.....	.....	14.3	13,903	14.3	.....	.....	14.3	41,058	37.4	8.2	.....	45.6

CITIES AND TOWNS in the Province of Saskatchewan.—Daily record of water consumption in Imperial gallons.

Month.	SUTHERLAND.					ESTEYAN.					SCOTT.									
	Population 1,080.					Population 580.					Population 500.									
	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.
January.....	4,345	1.6	2.0	.....	3.6	30,870	40.0	11.6	.....	10.1	13,064	9.6	.....	.....	16.4	13,064	9.6	.....	.....	26.0
February.....	2,318	1.8	0.1	.....	1.9	20,500	25.3	15.7	.....	41.0	19,357	9.9	.....	.....	28.8	19,357	9.9	.....	.....	38.7
March.....	2,192	1.8	.....	.....	1.8	29,741	29.2	1.0	.....	29.3	16,129	8.2	.....	.....	24.0	16,129	8.2	.....	.....	32.2
April.....	2,250	1.9	.....	.....	1.9	27,000	20.7	2.7	.....	30.6	18,350	9.9	.....	.....	26.2	18,350	9.9	.....	.....	36.1
May.....	1,968	1.6	.....	.....	1.6	30,580	28.9	2.6	.....	29.6	15,048	6.1	.....	.....	24.0	15,048	6.1	.....	.....	30.1
June.....	1,656	1.6	.....	.....	1.6	32,100	25.7	2.8	.....	25.0	13,858	3.6	.....	.....	24.1	13,858	3.6	.....	.....	27.7
July.....	1,572	1.6	.....	.....	1.6	39,516	41.6	2.6	.....	21.5	14,347	4.3	.....	.....	22.8	14,347	4.3	.....	.....	28.7
August.....	2,240	2.2	.....	.....	2.2	42,030	37.3	2.4	.....	24.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
September.....	3,513	3.5	.....	.....	3.5	30,166	26.3	3.7	.....	25.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October.....	2,690	2.7	.....	.....	2.7	31,129	25.5	2.5	.....	19.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
November.....	2,430	2.4	.....	.....	2.4	29,166	16.7	2.6	.....	25.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
December.....	5,227	2.5	.....	.....	2.5	26,774	23.8	2.5	.....	14.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average for year.....	2,700	2.1	0.4	.....	2.5	31,298	23.4	4.4	.....	21.4	15,693	7.4	0.2	.....	23.8	15,693	7.4	0.2	.....	31.4

CITIES AND TOWNS in the Province of Saskatchewan.—Daily record of water consumption in Imperial gallons—*Concluded*.

Month.	WEYBURN.			SWIFT CURRENT.					BATTLEFORD.				KINDERSLEY.								
	Population 5,400			Population 2,000					Population 2,500				Population 1,200								
	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.	
January.....	94,400	17.5	17.5	17.5	17.5	92,171	32.4	5.5	8.2	46.1	35,883	5.9	1.0	13.0	29.9	35,883	5.9	1.0	13.0	29.9	
February.....	94,400	17.5	17.5	17.5	17.5	81,918	29.2	5.0	6.8	41.0	18,143	6.1	1.0	2.8	15.1	18,143	6.1	1.0	2.8	15.1	
March.....	94,400	17.5	17.5	17.5	17.5	77,233	27.0	5.0	6.6	38.6	14,709	5.0	1.0	2.1	12.2	14,709	5.0	1.0	2.1	12.2	
April.....	101,980	17.7	1.2	18.9	18.9	75,234	27.5	4.7	5.4	37.6	8,537	5.0	1.0	2.1	7.1	8,537	5.0	1.0	2.1	7.1	
May.....	92,660	16.6	0.6	17.2	17.2						8,119	4.3	1.6	2.4	6.7	8,119	4.3	1.6	2.4	6.7	
June.....	86,792	16.0	0.1	16.1	16.1						8,672	4.8	1.6	2.4	7.2	8,672	4.8	1.6	2.4	7.2	
July.....	141,675	25.3	0.9	26.2	26.2						26,980	2.9	1.6	4.8	7.8	26,980	2.9	1.6	4.8	7.8	
August.....	136,570	24.0	1.3	25.3	25.3							5.3	1.6	2.5	7.8		5.3	1.6	2.5	7.8	
September.....	69,335	12.2	0.6	12.8	12.8							17,336	4.5	1.6	9.9	14.4	17,336	4.5	1.6	9.9	14.4
October.....	75,400	13.8	0.2	14.0	14.0							26,254	4.1	1.6	17.7	21.8	26,254	4.1	1.6	17.7	21.8
November.....	82,041	15.1	0.1	15.2	15.2							18,980	4.1	1.6	11.7	15.8	18,980	4.1	1.6	11.7	15.8
December.....	81,371	15.1		15.1	15.1							21,600	3.8	1.6	14.2	18.0	21,600	3.8	1.6	14.2	18.0
Average for year.....	95,919	17.4	0.4	17.8	17.8	81,639	29.0	5.0	6.8	40.8	26,980	2.9	1.6	10.8	14.9	26,980	2.9	1.6	10.8	14.9	

NOTE.—Swift Current totals are taken from individual meter readings. No allowances have been made for leakage.

NOTE.—In the Battleford result there is a great loss due to leakage.

CITIES AND TOWNS in the Province of Alberta.—Daily record of water consumption in Imperial gallons.

Month.	CARMANGAY.					Population 400.				
	Total Con- sumption.	Per head for domestic purposes.	Per head for other purposes.	Per head for Industrial purposes.	Per head for all purposes.					
January.....	15,129	37.8	8.2	.....	37.8					
February.....	20,250	42.4	8.2	.....	50.6					
March.....	16,484	41.2	.....	.....	41.2					
April.....	18,433	46.1	.....	.....	46.1					
May.....	.....	.....	.....	.....	.....
June.....	.....	.....	.....	.....	.....
July.....	.....	.....	.....	.....	.....
August.....	.....	.....	.....	.....	.....
September.....	.....	.....	.....	.....	.....
October.....	.....	.....	.....	.....	.....
November.....	.....	.....	.....	.....	.....
December.....	.....	.....	.....	.....	.....
Average for year.....	17,574	41.9	2.0	.....	43.9					

REPORT OF M. H. FRENCH, INSPECTING ENGINEER.

CALGARY, March 31, 1916.

I have the honour to submit herewith a report of the work done by myself and party during the season of 1915.

ASSEMBLING OF PARTY.

The party was assembled at Maple Creek the first part of May; after which we moved camp to Peacock's ranch on Hay creek and commenced the season's work. The party was disbanded December 10, the equipment stored in the storehouse at Maple Creek, and the horses returned to winter quarters at Needham's ranch, Piapot, Sask.

DESCRIPTION OF OUTFIT.

The personnel of the party, equipment, etc., were very similar to those of previous years. Besides myself there were an assistant, rodman, teamster and cook. We were housed in three tents, viz., an office tent, a sleeping tent and a cook tent. The transport consisted of two teams, a saddle horse, wagon and democrat.

DISTRICT COVERED.

The district covered this season was practically the same as that of previous seasons with the exception that it was extended westward to Range 29, necessitating the establishing of two extra camps.

WORK DONE.

The work during the season consisted of the usual inspections, trips, the preparation of amended general and detail plans and the right of way surveys of all works upon Crown lands. Although the first should be, and was, the most important part of our work throughout the greater part of the season, as much time could not be given to it as the work required during the latter part of the season because of the large number of right-of-way surveys I was unexpectedly called upon to make. However, with the exception of a few gauging stations still to be established upon a few ditches of minor importance and the taking of a few photographs and possibly a few small right-of-way surveys and amended detail plans, the district is in good shape and the department should be able to dispense with the usual irrigation party after this coming season. I will discuss an alternative method of conducting the work in another paragraph.

I shall not repeat anything in this report that has been mentioned in previous reports except one or two matters of great importance that should be further emphasized as having an important bearing upon irrigation development.

PRESENT STATUS OF IRRIGATION.

The attitude of the different irrigators towards the value of irrigation in this district is unquestionably optimistic, and any diverse opinions expressed by certain ones are generally the result of ignorance or narrow-mindedness and failure to grasp the fundamental principles of irrigation and its close relationship to the stock industry. Although most people are favourably disposed towards irrigation and fully realize the immediate direct returns to be derived from a judicious application of water at the proper time, for financial reasons chiefly they have not been developing their schemes to their maximum efficiency. Intensive irrigation is expensive and is not now considered absolutely necessary with the abundance of wild hay land available. Consequently irrigation, except in rare cases, is carried on only where the construction, maintenance and operating charges per acre are low. As in any other

branch of agricultural endeavour, improvements and developments take place slowly the greatest strides are always made in the initial periods of development. Nearly every scheme in my district has been completed and licensed in the last few years and as great apparent progress must not be expected henceforth as has been made in the past.

IRRIGATION AND DRY FARMING DEVELOPMENT INTER-DEPENDENT.

Since irrigation in this district will for some years be used mainly to obtain increased yields of hay, and since there are still large areas of unirrigable hay lands it follows that irrigation will not reach its maximum development until that other branch of agriculture, dry farming, also reaches its maximum development and brings all these unirrigable hay lands under cultivation. When that day arrives, and it is approaching very rapidly, then the products of the irrigated land will have risen enough in value to induce the irrigators to spend considerable time and money in developing their schemes to the fullest possible extent so as to get greater yields and obtain larger profits.

IRRIGATION AND DRY FARMING CORRELATED.

Irrigation will never supersede dry farming here because of the limited water supply and the great expense necessary for its complete conservation, but it will become a very valuable supplement to it in the future. From the irrigated lands will be obtained the large amount of hay necessary for the winter feeding of the herds of cattle grazed upon the unarable lands throughout the summer. In this way irrigation will prove the back-bone of the stock industry in this district later on when all the arable land has been put under cultivation. All this stock being raised in such close proximity to the farmers will enable them to dispose of a certain amount of the otherwise wasted roughage. The irrigator will be able to supply his hay or his cattle to the dry farmers who, with large quantities of crushed grain on hand, will be in a good position to do considerable winter feeding. In this way irrigation and dry farming are correlated, as it were, and not antagonistic, as many people suppose.

NEED OF EXPERIMENTAL WORK.

The greatest and most urgent need just now is reliable information concerning the most suitable crops to grow under all conditions and varieties of soil at widely varying altitudes, under different systems of irrigation, and with varying amounts of water available continuously in some cases and in others only in the spring. It will take several years to obtain and disseminate all this information, but the results will undoubtedly justify the expense. Considerable experimental work has already been carried on by different parties with considerable success. It seems to me that the department itself could carry on further experiments by interesting certain parties to set aside small plots of ground for this purpose, the work to be done under the direction of one of the officials of the department and paid for at a certain rate per hour. This might prove to be a better method than having just one centrally located experimental farm, because the conditions found at any one place would not be at all typical of the whole district.

I would recommend strongly that something be done by the department along these lines this coming summer. Although a policy of retrenchment must be rigorously followed this year, still a little reconnaissance work might be attempted, such as collecting information in regard to people who would be willing to co-operate in the work, cost of work, etc. Too much time can not be taken in this preliminary investigation because the results will depend entirely upon the way the work is started and carried along.

The experimental plots should be selected and located with a view of trying out a special phase of irrigation, or kind of crop, upon each plot. For instance, one plot should be located upon one of the heavy, alkaline flats in the Maple Creek valley. In connection with such a plot, a system of irrigation should be adopted to not only improve the fertility of the soil by removing the excess of the alkaline salts but also to grow fair crops at the same time. When the water is available only during the spring months, it should be determined what crops will thrive best with this one irrigation on different classes of soils. One or two plots could be located upon the bench at an elevation of about 3,080 feet above sea level. The amount of water applied and dates of application should be carefully recorded as well as methods of seeding, cultivation, etc.

After these plots have been located an accurate contour map of them should be made showing location of all structures, dykes, ditches, etc. If it is necessary to plough any ditches or dykes this work should be done. It may be quite necessary to separate the experimental plot from the rest of the field so that accurate duty of water data may be obtained.

The best manner of financing this work should be studied. It is quite axiomatic that something cannot be obtained for nothing. Therefore the work should be paid for at a reasonable rate.

ENGINEERS MAKING INSPECTIONS.

In regard to the inspections of the several schemes, I have noted that the district hydrometric engineer is in a much better position to get an idea of the irrigation work of the district than the regular inspector. He visits a large number of the schemes several times each irrigation season to ascertain the amount of water diverted through the ditches. While doing this he can easily observe the crops and keep track of things much better throughout the season than the inspector who sees one-third of the crops before they have hardly started to grow, and one-third after they have been cut and stacked. Information as to methods employed and water applied are in most cases obtained by the inspector by asking questions and not from actual observation.

REVISION OF DISTRICTS.

It seems to me that the districts should either be made smaller and the engineer in each district handle all the hydrometric and irrigation inspection work, or the irrigation inspector should try and get around two or three times each summer to all important schemes. Since the summer flow of all streams has been quite accurately obtained in this district such frequent gaugings could be dispensed with, thus leaving more time for other things; the first method, therefore, seems preferable.

For instance, instead of having two irrigation districts, and two hydrometric districts, divide the whole district into three or four separate districts with a man and an assistant in charge of each, handling all the hydrometric and irrigation inspection work. I would consider this method quite efficient. The districts could be made contiguous and the senior man could consult with the others in an advisory capacity.

SUMMARY OF WORK.

The following table summarizes the field work of the season:—

Total number of days.. . . .	229
Number of days field work and office work.. . . .	184
Number of miles travelled.. . . .	2,285
Number of reports submitted.. . . .	98
Number of plans submitted.. . . .	41
Number of quarter sections affected by R/W surveys.. . . .	67
Number of traverses for amended plans.. . . .	9
Number of gauging stations established.. . . .	19
Number of iron Bench-marks set.. . . .	27
Number of inspections.. . . .	113
Number of schemes recommended for license.. . . .	2
Number of unlicensed schemes.. . . .	11
Number of miles traversed.. . . .	98

REPORT OF H. R. CARSCALLEN—INSPECTING ENGINEER.

CALGARY, March 3, 1916.

I have the honour to submit herewith my report of the work done under my charge in the Western Maple Creek district during the season of 1915.

The period from the 12th of March to the 10th of April was spent on hydrometry work, the purpose being to obtain the early spring run-off on the streams in the vicinity of Battle Creek P. O., Sask. The next two weeks were spent in the Calgary office. During this time two special trips were made for the purpose of adjusting disputes between water users, one north of Maple Creek and the other southeast of Medicine Hat.

The work of organizing the camp was begun on the 26th of April. The camp was pitched about two miles south of Maple Creek and the work of getting horses in shape, outfitting the camp, repairing tents, etc., was undertaken. From this camp inspections were made by train, one north of Walsh and the other at Irvine. The camp was moved from Maple Creek to a point about thirty-five miles southwest on the 12th of May, and the regular inspection work for the season was started at that camp and carried on in the usual manner throughout the season. The work was accomplished from nine camps. The outfit was brought into Maple Creek on the 19th of November and stored, and the party disbanded. Six of the eight horses were turned out to winter pasture. One man was retained and one team of horses kept up for the purpose of making a special inspection trip. The season's field work was concluded the 1st of December.

The following schedule shows in brief and concise form the work done during the season, together with other information which may be of interest:—

Period of Field Work.		April 26 to December 1.
Number of work days.. . . .		190
“ days actual field work.. . . .		171
“ days unsuitable for field work.. . . .		19
Total number of inspections made.. . . .		90
No. of re-inspections made.. . . .		2
“ irrigation schemes in district.. . . .		79
“ “ “ licensed.. . . .		53
“ “ “ recommended for license in 1915.. . . .		3
“ “ “ recommend for cancellation in 1915.. . . .		2
Number of new applications.. . . .		9
“ ditch gauging stations established.. . . .		51
“ miles of traverse survey.. . . .		134
Plans submitted—amended general.. . . .		15
“ “ “ detail.. . . .		18
“ “ “ new schemes.. . . .		9
“ “ “ right of way.. . . .		18
Number of miles travelled by democrat.. . . .		3,515
“ “ “ train.. . . .		579

The work for the season was carried on in a similar manner to that employed other years. The party consisted of five men besides the inspector, viz., assistant draughtsman, rodman, cook and teamster. The camp outfit consisted of four tents and the usual requisites and the transport of one heavy wagon, two democrats and eight horses.

As may be seen from the above schedule a large amount of survey work was carried out during the past season in addition to the regular inspection work. The right of way surveys took up a great deal of time. In fact other work more in line with that which has been understood as the regular duties of an inspecting engineer had to be neglected or skimmed on this account, in order that the whole district might be covered in the season. It is considered that the inspecting engineer, to carry out the intention of the law which he is placed in any irrigation district, should examine carefully into the workings of each and every scheme with the idea foremost in his mind of suggesting improvements in the layout and construction of the works, also in the method of applying water to the land, the preparation of the land for various crops, suitability of

ferent crops in different localities, etc. Bearing these points in mind an inspector, to do full justice to a scheme which he is looking over, must not be hampered for time. In each of the three seasons which the writer has spent in this district the amount of survey work required was large and the need for speed in covering the district has always been paramount. However, the schemes are in such shape now with regard to suitable plans, rights of way, etc., that this condition may be said to be done away with. There remain only nine schemes which require amended plans and the necessity for such plans to be made is not pressing. The collection of data for these plans may be spread over two or more years, depending upon the time the inspector may have at his disposal for such work. Only a few right-of-way surveys remain to be made and they are all quite small. I would, therefore, recommend cutting down the party to four men, the inspector, assistant, teamster and cook. The transport and camp equipment may be reduced in accordance with the decrease in the number of the party, the former to a heavy wagon, one democrat and four horses, the latter to three tents and the necessary requisites.

DITCH-GAUGING STATIONS.

A large number of ditch stations were established during the season, fifty-one in all. At five of these stations permanent wooden weirs were installed. The difficulty of procuring the necessary lumber was responsible for the fact that more of these weir stations were not constructed. As stated in previous reports it is a matter of very great difficulty to impress upon the irrigators the importance of the records of flow in their ditches. In a great many cases it was necessary to establish the stations at a considerable distance from the residence of the ditch owner and it is a fact that in such cases daily observations cannot be obtained from these men. To insist that such frequent readings be taken would only result in antagonizing the owners of the schemes without bringing about the desired result. In these cases the importance of the records was explained and they were asked to make as many accurate observations as possible.

Including schemes still uncompleted there remain eighteen on which gauging stations require to be established. For these schemes a total of thirty-four stations will be necessary. Many of these schemes divert from streams of little or no importance. Only three completed schemes require gauging stations in the near future, viz: that of Mr. E. F. Harms, of Messrs. A. H. and A. D. Mackinnon and of Mrs A. McLaren. These three schemes will require eight stations in all.

PHOTOGRAPHS.

Upwards of three hundred photographs pertaining to irrigation were taken during the season. A large number of these comprise general views of schemes in flat prairie country and beyond demonstrating this fact are necessarily most uninteresting. Very few more photographs are necessary to complete the photographic records of the schemes in this district.

GENERAL.

The past season was a very poor one for construction work owing to the great amount of wet weather. With the exception of a short time in the spring of the year and a few weeks in mid-summer, rain or snow occurred at such frequent intervals as to keep the soil in a moist state continuously. A great part of the irrigated land in the district is heavy, generally gumbo, and almost impossible to work when wet. Only three schemes were recommended for license during the year. Of the remaining twenty-three unlicensed schemes, ten are nearing completion and should be finished and ready for license, this coming season.

It has been suggested that some form of systematic experimental work along irrigation lines be instituted in the Cypress hills. Some work of this nature is very badly needed and the time is certainly ripe for it. Here and there throughout the district irrigators have been doing a little experimental work on their own initiative, mostly along the lines of suitability of crops. The knowledge gained by such experiments is of benefit only to themselves and possibly their close neighbours. Some system should be evolved whereby important information of this kind may be placed at the disposal of all the men interested in irrigation in that part of the country. There are many different sets of conditions under which irrigation is carried on throughout the Cypress hills. This is very apparent from the fact that this large irrigation tract lies in the range of hills. Irrigation is carried on at elevations ranging from 2,300 to 4,000 feet above sea-level. From this it can be seen that investigations of the kind suggested must be spread over a large area throughout the hills in order to cover all the conditions to be met with. One central experimental farm would not fulfil the purpose, it would merely experiment under one set of conditions. There are irrigators here and there in the hills who take a markedly active interest in irrigation and who are ever anxious to do what they can for the betterment of their schemes. Such men could, if the purpose of the investigations proposed were properly explained to them, be induced to co-operate with the department in this work. Each man could set aside one or more plots of ground on which various crops in which they are interested could be planted and complete records kept of methods of cultivation and irrigation. This work should be done at the expense of the department. The various plots could be placed under the supervision of the district engineer who is in a better position to do this work than the irrigation inspector since he makes many rounds of his district in the season.

REPORT OF R. H. GOODCHILD, INSPECTING ENGINEER.

CALGARY, March 6, 1916.

I have the honour to submit herewith the general report of work done by me in the Calgary Irrigation district, during the season of 1915.

As mentioned in previous reports, this district comprises the territory lying between the Calgary and Edmonton railway on the east and the Rocky mountains on the west, and between Townships 3 and 29.

Outside work was begun on April 26, and on December 15, I was forced to abandon work on account of the severity of the weather. With the exception of a very few weeks at the close of the season, the weather was exceptionally wet. Heavy and long continued rains, snow, and, during the fall, hurricanes of wind and snowstorms made work very difficult and often impossible.

In the hill country, which comprises the biggest portion of the territory in this district, the rain was so continuous and so heavy that the main routes of travel were for a large part of the season almost impassable.

From this cause I was greatly delayed, and was obliged to abandon the usual routes followed by me in past years, and I found it impossible to reach a large part of the hill country until the ground was frozen and the trails passable.

On account of the superabundance of rain, there was practically no irrigating done, and none was, of course, required.

The streams in consequence of the heavy rain were at times torrents, and irrigation headworks, especially in the northern portion of the district, frequently suffered severe damage. This damage is perhaps of more consequence than would appear at first glance, for the reason that on account of the wet and stormy weather prevailing throughout the season very little repair work was done during the summer on schemes that required it, and if irrigation is required next season a considerable number of schemes will be unserviceable.

More surveying was done this year than was ever before attempted, including a number of right-of-way surveys which of course require more care and time to complete than the ordinary surveys made for the preparation of new plans. These right-of-way surveys, with such a small party as was at my disposal, took up a considerable portion of the time usually spent on inspection work, and prevented my completing all the inspections in the district. In this connection, I beg to point out that there is, in my opinion, a very considerable number of licensed schemes that need not be inspected every season, especially if the season is bad, or pressure of surveying work heavy, and I think that an inspection every two years of such schemes would suffice.

The work done during the season may be summarized as follows:—

Number of inspections of irrigation schemes.. . . .	89
“ “ domestic schemes.. . . .	6
“ “ municipal schemes.. . . .	3
“ “ industrial schemes.. . . .	2
Total.. . . .	100
Number of miles of traverse run.. . . .	42'05
Plans submitted, (sets) new general and detail.. . . .	4
“ “ right of way.. . . .	7
“ “ amended general.. . . .	6
Miles travelled by trail.. . . .	1,460
“ “ rail.. . . .	640

The schemes in this district are made up as follows:—

Irrigation.. . . .	90
Domestic.. . . .	6
Municipal.. . . .	3
Industrial.. . . .	2
Total.. . . .	101

And the conditions are, as follows:—

No. of licensed schemes.. . . .	91
“ schemes authorized and under construction.. . . .	5
New applications reported feasible.. . . .	5
Total.. . . .	101

The time taken was used as follows:—

	DAYS.
April 26 to December 16 (incl.).. . . .	235
Sundays.. . . .	34
Days lost through bad weather and impassable trails.. . . .	18
“ “ sickness and other causes.. . . .	8
Days spent in Calgary on plans and hydrometric work.. . . .	21
Days spent on work or travelling.. . . .	154
Total.. . . .	235

REPORT OF P. J. JENNINGS, OFFICE ENGINEER.

I have the honour to submit the following report upon the work in connection with special inspections carried out under my supervision, and by myself as office engineer, during the year 1915.

SPECIAL INSPECTION WORK.

This work includes the organization and direction of all special inspections in the provinces of Alberta and Saskatchewan. Messrs. C. Chambers and F. R. Burfield were again engaged on this work, Mr. Chambers taking the inspections in Alberta and Mr. Burfield those in Saskatchewan.

The system inaugurated last year for the handling of this work, as outlined in my report under this heading, worked very satisfactorily and it was possible at any time to readily ascertain the work already done, the work in hand, and that remaining to be done.

An effort has been made during the past season to have every irrigation scheme inspected. In cases where very unsatisfactory plans had been filed sufficient information to enable suitable amended plans to be prepared was obtained.

Mr. Burfield experienced a great deal of difficulty in obtaining liveries in certain parts of Saskatchewan, and has suggested that at times economy could be effected by the use of automobiles. It is now possible to hire an automobile for a great deal of the special inspection work, at prices which compare favourably with the hire of teams. On individual inspection trips where there is only a short stay required and no survey work to be done the use of automobiles would greatly add to the efficiency of a special inspector. In the case of special inspection work an amendment to the existing staff regulations with reference to the hire of automobiles should now be authorized.

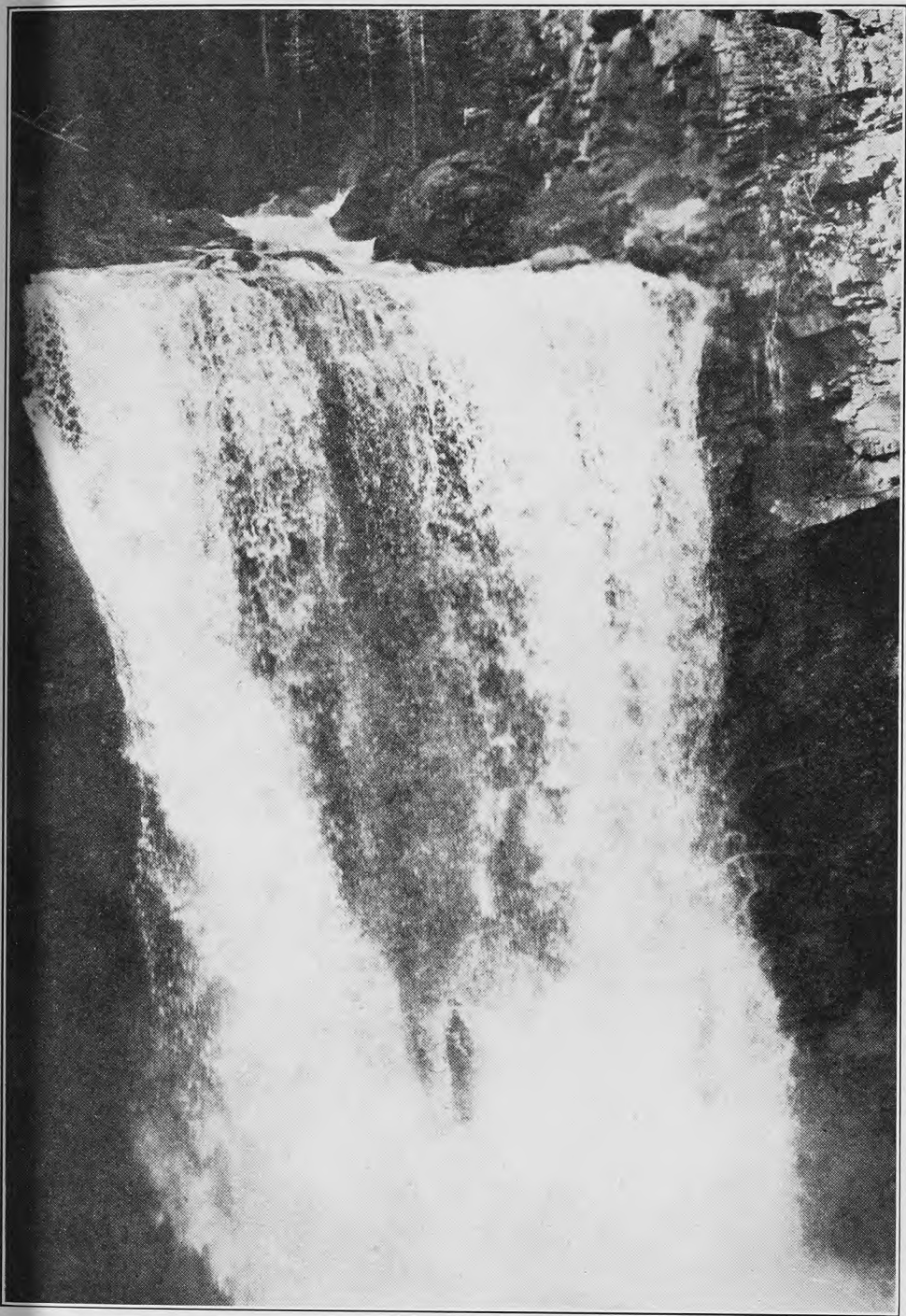
Preliminary investigations were undertaken by Mr. Burfield with a view to the feasibility of obtaining a suitable water supply for the principal cities of southern Saskatchewan, from Wood river near lakes Johnston and Chaplin, a separate report on which has been submitted.

Mr. Burfield made seventy-eight inspections and travelled 10,152 miles by train and 2,068 by road with team and democrat. The cost per inspection amounted to \$31.02. The necessity for engaging an assistant in connection with the re-survey made and the scattered nature of the work has resulted in the cost per inspection being a little higher than in previous years.

Mr. Chambers' work included a large number of industrial schemes, such as railway water supplies, which were readily accessible from the railways. Six schemes were surveyed by Mr. Chambers and in most cases the necessary help was available without hiring. Seventy-one inspections were made during the season, the first on 25th March, and the last on the 30th December. The cost per inspection was \$34.25, a little higher than previous years' inspections owing to the fact that in the past the time spent in office between inspection trips was not included by Mr. Chambers in the total cost of his work.

During the past year there has been a marked increase in the number of applications from public bodies, particularly from rural municipalities, for water rights on small springs within their municipality, for the domestic use of the community. It is usually found upon investigation that the water supply has been used by the public for some time, but disputes between some of the users and the riparian owner have generally led to access to the spring being refused. The municipality has then been prevailed upon to submit an application to divert water from the spring for the domestic use of the community. The onus of making arrangements for access to the springs is thus thrown upon the municipality, who have the same difficulties to overcome in endeavouring to make an amicable arrangement for an easement with the owner.

It is certain that there is a number of cases in the provinces of Alberta and Saskatchewan where water is being diverted for domestic and industrial use without authority from this department. Mr. Burfield has suggested that some good might be done by circularizing the various local authorities with reference to the bearing of the Irrigation Act in such cases. The suggestion is a good one and could be followed up with very little expense to the department. If the idea is approved, the suggested circular should deal particularly with that portion of the Act having a direct bearing on riparian ownership and should point out clearly the rights a riparian has for domestic requirements as well as his rights under Section 11 of the Irrigation Act. It might further be pointed out that, in all cases where a supply of water is to be taken from a spring which is already being used by the riparian, any right to water therefrom which



Falls about 110 feet high on East Branch of Belly River, 2 miles above forks.

Taken by F. H. Peters.

can be granted by this department, is at all times subject to the rights of the riparian user. In this way it should be made clear to the applicant or applicants, in cases where the supply is limited or intermittent, that their rights are at all times subject to those of the riparian owners.

Railway Water Supplies.—An effort has been made during the past season to check up the various railway water supply tanks throughout the two provinces with a view to discovering illegal diversions. From a study of the reports submitted by Messrs. Chambers and Burfield, it appears the reason a large number of the tanks were not recorded in the department, was that the supply was obtained from wells and consequently did not come within the purview of the Irrigation Act. There was, however, quite a number of unauthorized diversions discovered which fully justified the time spent in the investigations. These are now being followed up and applications are being made in accordance with the law.

Irrigation Inspections.—In the province of Saskatchewan there are twenty-one irrigation schemes which come within the scope of the personal inspections, being too widely scattered to be dealt with by the district engineers working out of Maple Creek. Nineteen of these were inspected during the season and re-surveys made in a number of cases. Gauge rods and bench-marks were established on ten of the irrigation schemes inspected in this province.

The general condition of the irrigation schemes inspected by Messrs. Chambers and Burfield, was found to be unsatisfactory. Many of the schemes are owned by ranchers who have a very limited knowledge of irrigation, the methods of application, and the benefits that can be obtained therefrom. The works in most cases are allowed to fall into a bad state of repair and no attempt is made to use water until a very dry period occurs, when it is usually too late in the limited time at their disposal to get the works into shape for carrying the water so as to be of any material benefit. I do not think that at the present time any good purpose would be served by the cancellation of many of these licenses. The matter will eventually adjust itself as time goes on and the settlement of the country advances to a point where it becomes necessary to utilize every acre of land that can be profitably cultivated for raising grain or stock feed. In the meantime the importance of a fuller development of the areas under irrigation should be continually urged upon the settlers, and records of the increased yields of those who are applying the water to their lands successfully brought to their notice.

In connection with the annual inspection of irrigation schemes, and especially those along the South Saskatchewan and the Red Deer river, I would suggest that in future these schemes be taken all in one tour by means of a team and democrat. It has been customary in the past to go by rail to the nearest point and then hire a team for the remainder of the journey. More efficient work could be done by the inspecting engineer if he were given a team and democrat with one helper and a light camping outfit.

Drainage Inspections.—Two inspections of projected drainage schemes were inspected in Saskatchewan and eight in Alberta. With but one exception these were all schemes of a minor nature, usually for the lowering or removal of small bodies of surface water adjoining lands owned by the applicants.

Photographs.—Photographs of the various schemes inspected have, whenever possible, been taken. It has been urged by the special inspecting engineers that a special effort be made during the coming season to have the developed views returned from Ottawa at an earlier date, so as to enable them to become acquainted with the individual qualities of their cameras as early in the season as possible.

SPECIAL INSPECTIONS MADE DURING SEASON 1915.

	P. J. Jennings.	C. Chambers.	F. R. Burfield.
Domestic.....		7	32
Municipal.....	1	5	2
Industrial.....		24	14
Irrigation.....	1	20	25
Other { Drainage.....		8	2
{ Miscellaneous.....	3	2	3
Illegal diversion.....		5	
Totals.....	5	71	78

	C. Chambers.	F. R. Burfield.
Surveys made (including those for construction).....	6	32
Right of way surveys made.....	0	5
Plans submitted.....	6	22
Ditch rods established.....	3	10
Miles travelled—by train.....	6,550	10,152
“ “ —by trail.....	2,367	2,038

Office work.—The work accomplished during the past year has been of a routine nature, and has included the usual examination of all plans of works and general plans submitted for approval, in accordance with the provisions of the Irrigation Act.

A larger number of right-of-way plans has been submitted this year than ever before, and this has entailed much careful checking of plans and descriptions.

A great deal of difficulty is still being experienced in getting sufficient information upon plans submitted for approval by applicants for rights under the Irrigation Act. The consequence is unnecessary correspondence and delay before the application can be acceptable for authorization.

Blue-prints of standard types of approved irrigation structures are now being furnished in all cases where the works already constructed are not of a serviceable and effective type. In these cases the licensee is asked to follow the improved type of structures referred to on the amended plans, when his present works become ineffective through decay.

During the year five inspections were made by the office engineer and the necessary reports submitted thereon.

On the 23rd, 24th and 25th of November, I was privileged to attend the Ninth Annual Convention of the Western Canada Irrigation Association, held at Bassano, being an accredited delegate from the Canadian Society of Civil Engineers.

In the course of the year the following plans were examined:

	Examined and approved.
(1) For domestic purposes.. . . .	7
(2) " municipal purposes.. . . .	10
(3) " industrial purposes.. . . .	53
(4) " irrigation purposes.. . . .	53
(5) " other purposes.. . . .	2
(6) " reclamation by drainage.. . . .	2
(7) " right of way purposes.. . . .	60
(8) Plans amended.. . . .	19
(9) Right of way descriptions checked.. . . .	56
Total.. . . .	262

REPORT OF SAM G. PORTER, ASSISTANT CHIEF ENGINEER.

CALGARY, March 31, 1916.

I have the honour to submit the following report on the inspection of the large irrigation systems during the past season.

EASTERN SECTION CANADIAN PACIFIC RAILWAY IRRIGATION BLOCK.

Construction.—No construction has been in progress during the year, but the canals and structures on a large portion of the tract have been inspected in connection with the land classification work.

Operation.—A small amount of water was delivered to the farmers in the Bassano, Rosemary and Sutherland colonies. Also storage water has been run to lake Newell, increasing the level from several feet below the zero of the outlet gates to 3.6 feet above.

Land Classification.—A field party has continued the previous season's work on the inspection and classification of the irrigable land in the Eastern Section of the Canadian Pacific Railway Company's Irrigation Block. The party consisted of J. S. Tempest, Field Engineer, P. A. Fetterly, Assistant Engineer, two rodmen, two teamsters and a cook. The field work extended from April 12, to October 1, 1915. An irrigable area of approximately 126,000 acres was inspected, but further investigations of the drainage and alkali conditions are necessary in respect to a part of that area.

There yet remain to be inspected all the area under the Rolling Hills canal; the greater part of the area under the West Bantry canal; a small part of the area under the South Bantry canal, and sundry small areas at various points which have been held for further investigations.

THE TABER IRRIGATION DISTRICT.

The Taber Irrigation District has been organized by the farmers between Chin Coulee and Taber, under the provisions of the Provincial Irrigation District Act. The district contains about 20,000 acres of first-class irrigable land which can be irrigated by a proposed canal taking out of Chin Coulee reservoir, already constructed by the Alberta Railway and Irrigation Company. The water will be supplied to the reservoir through the main canal of the Alberta Railway and Irrigation Company's system during the non-irrigation season and at times of surplus supply during the irrigation season.

A study of the water supply indicates that there is an ample supply available for 17,000 acres and it is proposed to limit the area to be served to that amount.

The field party under Mr. Tempest, which had been engaged in the classification of Canadian Pacific Railway Company's Eastern Section lands, made a thorough classification of the lands in the Taber Irrigation district, from October 2, to November 23, 1915.

THE SOUTHERN ALBERTA LAND COMPANY.

During the flood in the Bow river in June, 1915, a part of the diversion dam the south channel of the river failed and the concrete apron below the spill dam the north channel was damaged. Repairs to the apron were completed and preparations for making repairs to the dam were started but actual reconstruction has not yet been accomplished.

Aside from these operations no work has been in progress by the Southern Alberta Land Company during the year.

THE ALBERTA RAILWAY AND IRRIGATION COMPANY.

This system has been operating as usual. No field inspections were made during the season.

THE LETHBRIDGE NORTHERN IRRIGATION PROJECT.

An inspection was made of the irrigable lands and proposed canal system for the purpose of making a general report on the feasibility of the project, which is being thoroughly investigated by this Branch.

THE MILK AND ST. MARY RIVERS IRRIGATION PROJECT.

A similar inspection, though not so much in detail, was made of the large area comprised in the proposed Milk and St. Mary Rivers project, for which preliminary surveys have been made by this Branch.

OFFICE WORK.

In addition to the correspondence and ordinary routine office work carried on under my supervision, I have examined for approval by the Commissioner, the following plans:—

Eastern Section C.P.R.—Contour plans of irrigable lands, 10 townships, 10 sheets. Structure plans, 71 plans, 102 sheets.

Western Section C.P.R.—Structure plans, 13 plans, 19 sheets.

A. R. and I. Co.—Structure plans, 1 plan, 1 sheet.

Taber Irrigation District.—Contour plans of irrigable lands, 58 sections, 58 sheets.

In addition to these, which have been signed for approval, a large number of plans, profiles and maps have been studied and used in connection with the land classification work and various reports but they have not yet, for one reason or another, been passed for official approval.

Mr. Tempest and Mr. Fetterley have been engaged during the winter season working up and tabulating the results of the field inspections of irrigable lands in the Eastern Section of the Canadian Pacific Railway Company's Irrigation Block and the Taber Irrigation District. Mr. Marshall has handled the checking and filing of water agreements and sundry details of office procedure. Mr. Miller, Assistant Office Engineer, has been engaged in working up classification maps of irrigable areas, checking canal capacities and absorption losses and similar work connected with the approval of irrigable lands in the Canadian Pacific Railway Company's Eastern Section and Taber Irrigation District.

REPORT OF B. RUSSELL, CHIEF FIELD INSPECTOR.

CALGARY, March 15, 1916.

I have the honour to submit herewith my annual report of the field work carried out during the past season under my supervision.

LETHBRIDGE NORTHERN IRRIGATION PROJECT.

The Lethbridge Northern Irrigation project, previously known as the "Old Man River Diversion project," has been under the consideration of this department since 1913, when the first surveys were made and the scheme found to be feasible and worthy of further investigation.

PREVIOUS SURVEYS AND REPORTS.

The field work during 1913 consisted mainly of a preliminary survey of various canal routes, and a rough topographical survey of the lands to be served with water. A full description of this scheme together with a rough estimate of cost of construction was submitted and published in the annual report of the Commissioner of Irrigation for 1913.

During 1914 further and more detailed surveys were carried out, in connection with this project, consisting of preliminary surveys of secondary canals and a more detailed topographic survey of the irrigable areas.

A fairly close study of the whole project was made upon the completion of the field work for 1914, and it was considered that sufficient surveys had then been made until such time as the occupants of the lands under consideration showed sufficient interest in such a project to justify more detailed surveys.

It was soon evident that the settlers, particularly in that section of the country in the vicinity of Iron Springs, where the effects of the dry seasons were most keenly felt, appreciated the value of irrigation to their lands and, as a result of petitions by these interested parties, it was considered advisable to continue the surveys during 1915.

PLANE TABLE SURVEYS.

In the spring of 1915 three plane table parties under V. Meek, C.E., were sent into the field, the object being to make very accurate contour surveys of each section of land under the project, from which the portions of irrigable area could be accurately determined and an adequate distribution system of canals projected and designed and cost estimates prepared.

Mr. Meek started his field work on 1st May, the work progressing at the average rate of 221 acres per plane table per day until the 16th September, when three additional plane tables were provided.

During the season the total number of acres plane-tabled was 149,515, and the estimated cost per acre for this work was about ten cents.

SOIL TESTS.

Mr. Meek was provided with an electrical bridge for testing the alkalinity of the soil, and during the season some forty-three soil samples were taken throughout the district and tested. Although these tests showed the presence of some alkali, it was found that most of the land is comparatively free from harmful salts. It is expected that a great many more samples will be tested during the next season so that any of the land which may possibly be found to be dangerously impregnated can be excluded.

EXTENSIONS.

The possibility of extending this project to take in lands in the Sundial district was mentioned in the annual report for 1914, and during the past season Mr. Mc made some preliminary surveys in this connection to determine the feasibility of such an extension.

Preliminary surveys were made for a canal running north from the Iron Springs district crossing the Little Bow river in Sec. 13, Tp. 14, Rge. 21, W. 4th Mer., and connecting with the Southern Alberta Land Company's canal where it turns east from the banks of the Little Bow river. Although the country north of Iron Springs through which such a canal would have to be constructed is very rough, and a syphon 3,200 feet long under a head of 210 feet would be required to carry water across the Little Bow river, it is thought, provided a sufficient quantity of water is available, that such an extension would be feasible and that possibly 93,000 acres of land could in this way be irrigated in the Sundial district.

A further reconnaissance was made during the season to determine the feasibility of extending the Lethbridge Northern project to irrigate land lying east of the proposed intake between the Old Man and the Belly rivers. It was found that there is considerable area of land suitable for irrigation in this district and, although the main canal for a few miles along the banks of the Old Man river would be very expensive to construct, it is thought that such an extension would also be feasible, provided the water supply is adequate for the purpose.

TEST BORINGS.

Before a reliable estimate of the cost of structures can be made it will be necessary to test the foundations by digging test pits. The foundations govern to a very large extent the design and cost of the structures. Test pits will also be necessary in order to determine the character of the material from which the canals will be excavated.

It is the intention during the coming field season to place a party in the field properly equipped to make these test borings so that upon the completion of next season's field work it will be possible, from the information obtained, to make a more complete and accurate estimate of the cost of constructing the project.

RESERVOIR SITES.

The only reservoir site which has been seriously considered so far in connection with this project is what is known as the Kehoe Lake reservoir, situated in Township 1 Ranges 22 and 23, West of the 4th Meridian. Accurate surveys have been made of this site and it is estimated that some 41,000 acre-feet of water can be stored there.

CASTLE RIVER RESERVOIR SITE.

A reconnaissance of a reservoir site on the Castle river was made last year by Messrs. G. H. Whyte and W. R. McCaffrey, and from their reports it would seem that if a dam could be constructed at reasonable cost it might be of some value to this project.

This question of storage was gone into more thoroughly in a report submitted to the Commissioner in January, 1916, and as a result of studies made of storage problems it is expected that a further investigation of this site will be made during the next field season and sufficient information gained to enable us to make a rough estimate of the cost of such a reservoir in order to determine its feasibility.

OFFICE WORK.

An office classification of the irrigable areas plane-tabled in 1915 is now well under way but it is not expected that this can be completed by the end of the fiscal year.

As previously pointed out the area plane-tabled to date is 149,655 acres. This area covers portions of 251 sections and, since a distribution system of canals must be designed and projected to each of these sections and each one classified, there is an immense amount of office work involved.

It is expected that an office staff will continue this classification throughout the coming summer so that at the end of the year 1916 all of the work in this connection will have been completed.

MILK AND ST. MARY RIVERS SURVEY.

Preliminary surveys, to determine the amount of irrigable land in Canada tributary to the Milk and St. Mary rivers, were made during the field season of 1914 and a report submitted and published with the annual report of the Commissioner of Irrigation for that year. Further surveys were continued throughout 1915 and it is the object here to show briefly what was accomplished during that year.

As stated in last year's report, the primary object in making these preliminary surveys was to determine the amount of irrigable land in Canada tributary to the Milk and St. Mary's rivers, in order that this information should be at the disposal of the Commission investigating the question of a proper division of the boundary waters between the United States and Canada. Although it was roughly estimated, from the preliminary surveys made, that there were some 550,000 acres of land in Canada tributary to the Milk and St. Mary rivers susceptible of irrigation, it was necessary in order to determine more fully the feasibility of irrigating all this area, to make further surveys of a system of canals and reservoirs as well as to carry out a more detailed topographical survey of the irrigable areas

RESULT OF PREVIOUS SURVEYS.

Although the results of the surveys made in the year 1914 have been submitted, and published, in a general way, in the report of the Commissioner of Irrigation for that year, it is necessary to discuss briefly here the several systems of canals and reservoirs which were found to be most practical, for diverting the required amount of water from the rivers, and carrying it to the lands under consideration.

It was estimated last year that there were some 550,000 acres of land in Canada, tributary to the Milk and St. Mary rivers, susceptible of irrigation. Some 175,000 acres of these are in the vicinity of Magrath, Raymond, Lethbridge and Coaldale and the remaining 381,000 acres lie to the south and east of the Lethbridge-Coaldale district.

In order to irrigate all of this area it was found necessary to provide a large quantity of water from both the Waterton and Belly rivers, as well as all of the available water from the Milk and St. Mary rivers.

Two systems of canals were projected and a study of the available water supply and irrigable areas made under each system. The first system of canals anticipated irrigating practically the whole of the 550,000 acres, or to be exact, 548,456 acres, estimated to be susceptible of irrigation, while the second system only anticipated irrigating some 353,000 acres which only included what were considered the most feasible tracts to irrigate. Both of these systems anticipated utilizing the present system of canals of the Alberta Railway and Irrigation Company, and the areas under each include the 100,000 acres now capable of being irrigated by this company and also the 17,000 acres known as the Taber extension to their present project.

Under the first system of canals it was proposed to divert a maximum quantity of 1,000 second-feet of water from the Waterton river and 692 second-feet from the Belly river, in addition to the available supply from the Milk and St. Mary rivers, while under the second system it was only proposed to divert a maximum quantity of 600 second-feet from the Belly river in addition to the available supply from the Milk and St. Mary rivers.

In order to divert 1,000 second-feet from the Waterton river it was estimated that a storage reservoir of 26,400 acre-feet capacity would be required, and in order to divert a maximum quantity of 692 second-feet from the Belly river, it was estimated that it would be necessary to create storage reservoirs of 34,600 acre-feet capacity on this river.

In addition to the above required storage it was found, that in order to irrigate the lands under the first system of canals, a storage capacity of some 409,000 acre-feet would be required, and to irrigate lands under the second system, storage capacity of some 246,000 acre-feet would be required.

The locations of the storage reservoirs in which it was proposed to store the required amounts of water under each of these systems is shown in the report submitted for 1914.

FIELD WORK DURING 1915.

Only two parties were engaged upon this work during the field season of 1915. One party in charge of T. M. Montague, C.E., was instructed to first make a preliminary survey for the proposed canal from the Waterton river to the St. Mary river, then to make a contour survey of a proposed reservoir site on the St. Mary river in Sections 4 and 9, Township 1, Range 25, W. 4th Meridian, and afterwards to run a sufficient line to determine the locations of main canals to the several tracts, as well as to assist in making topographical surveys of irrigable areas and possible reservoir sites throughout the district under consideration.

A second party under N. M. Sutherland, C.E., was instructed to make surveys for main canals through the several tracts of irrigable land and also to make topographical surveys of the irrigable areas and possible reservoir sites throughout the district.

It was realized that two parties could not complete these surveys over the whole of the area under consideration during one season, so that it was necessary to first complete those tracts which were considered to be the most feasible to irrigate, and then continue the work throughout the other tracts, and this is the manner in which the work was carried out.

The method of carrying out this work and the progress made during the season will be found in the reports submitted to the Commissioner by the officers in charge, but as these detailed reports are not to be published, it is necessary here to report briefly the progress made with this work.

PARTY NO. 10.

Mr. Montague assembled his party at Cardston on April 22, and moved camp on April 23, to the Waterton river where his field work was started.

Reconnaissance.—A reconnaissance was first made for a dam site at the upper Waterton lake and cross-sections were made at two possible dam sites, one at the lower end of the lake and the other at the "Narrows" some two miles farther up. A reconnaissance was then made of the river valley between the Waterton lakes and the south boundary of Tp. 4, Rge. 28, W. 4th Mer., for the purpose of determining the most feasible point from which to divert water from the river. This point was found to be in Sec. 29, Tp. 3, Rge. 28, W. 4th Meridian. A dam 215 feet in length and ten feet in height would be required in order to divert the water at this point, and the indications are that there is good foundation and that a diversion dam could be constructed very cheaply at this location.

Canal route.—Owing to the very unfavourable weather of last spring Mr. Montague and his party were engaged upon this work until the 1st July, however, considering the nature of the country through which such a canal would have to be built, a very good line was located.

After leaving the proposed diversion dam on the Waterton river, the line as surveyed crosses a wide flat on the river bottom and then follows the side of the river valley for some five miles when it comes out on the higher lands, and finally gets away from the river. At some points throughout this five miles there would be difficulty in constructing a canal, owing to the steepness of the side hills, but there are no very bad sliding banks, and it is thought that a canal could be built without very much difficulty, although no doubt it would require considerable maintenance for the first few years of operation at least.

From where the line comes out on the higher lands in Sec. 2, Tp. 4, Rge. 28, W. 4th Mer., it follows in a southerly direction along the watershed of the Belly river to practically a grade crossing of this river in the SW. $\frac{1}{4}$ Sec. 12, Tp. 3, Rge. 28, W. 4th Meridian. At this point the river can be crossed by a flume approximately 250 feet long and six feet high, or a low dam constructed here to divert Belly river water into the canal.

After crossing the river and again coming out on the higher lands on the east side of the Belly river, the line is in the Blood Indian reserve, and follows up the valley of Mami creek. Since this creek has a very heavy fall it was only necessary to follow the valley for a short distance in order to cross at grade. Here it would be possible either to cross by means of a short flume, or to construct a low dam and divert water from the Belly river into the canal.

It should be mentioned here that in the discussion last year it was proposed to divert the Belly river at Sec. 4, Tp. 2, Rge. 28, W. 4th Mer., to turn it first into Mami creek, then into Bullhorn coulee, picking it up from there in the canal from the Waterton river. It was not thought possible to cross the Belly river and Mami creek at grade. Since, however, the surveys show that it is quite feasible to divert the Belly river directly into the canal at the SW. $\frac{1}{4}$ Sec. 12, Tp. 3, Rge. 28, W. 4th Mer., this is no doubt the better scheme.

No serious obstacles were encountered between Mami creek and Lee creek but the crossing of the latter will be very expensive. Several crossings of this creek were surveyed but it was found that a syphon at least 3,000 feet in length under a head of 140 feet will be required to carry the water across.

From Lee creek to the St. Mary river the line is located through an easy country, and the construction of a canal would not be difficult.

In order to deliver the water behind the head gates of the Alberta Railway and Irrigation Company at Kimball (which is necessary in order to again divert it through their system to the lands under consideration), it is necessary to follow up the valley for some distance. The line was continued up this valley and it was found that the country was very broken. A number of flumes will be required along this stretch, in order to carry the water across coulees and the work will be difficult and expensive.

Although an estimate of this work has as yet not been made it is thought feasible to construct a canal between the Waterton and St. Mary rivers, although the feasibility depends altogether upon the value of the water for irrigation.

Reservoir site, Secs. 4 and 9, Tp. 1, Rge. 25, W. 4th Meridian.—Upon completing the surveys in connection with the Waterton river, canal Mr. Montague moved camp to a suitable location and started his surveys of the proposed reservoir in the St. Mary river at the above location.

It was pointed out in last year's report, that although this is not a very desirable site for a reservoir, it is the only site on the St. Mary river in Canada where any amount of water can be stored, and is considered important on this account.

In the discussion of the available water supply in last year's report it was assumed that Canada could divert 55 per cent of the total annual discharge of the St. Mary river at the boundary line, and this was only possible under the assumption that the United States would include in their share of 45 per cent of the annual flow of the stream, all of the winter flow, which could easily be stored in their reservoir at St. Mary lakes. Unless the United States will create storage at St. Mary lake, or other-

wise take care of the winter discharge of the stream it will not be possible without storage on the St. Mary river to utilize anything like 55 per cent of the discharge of the St. Mary river. Hence the importance of this reservoir site.

Since this site was partly surveyed in 1914, Mr. Montague was only two days in completing this work. It was roughly estimated in last year's report that it might be possible to store 37,000 acre-feet of water at this site with a dam 105 feet in height. Estimates made since the survey has been completed show, however, that only some 20,000 acre-feet can be stored at this site.

Brunton Reservoir Site.—Mr. Montague upon completing surveys of the above reservoir site was instructed to make all the necessary surveys for the further development, in regard to irrigation possibilities, of what were last year called tracts 7A, 7B and 7C, or that stretch of country lying to the east of Verdigris coulee between Etz-kom coulee and Milk river. Before locating any of the main canals to this area it was first necessary to make a survey of Tyrrell lake to determine the possibilities of storage. When earlier surveys were made of the district, this site was known as the Brunton Reservoir site, and will be referred to as such in this report. It is formed by Tyrrell lake and Suds lake, which lie in a wide valley in Tp. 5, Rges. 17 and 18, W. 4th Mer. This valley extends from a point near New Dayton to the Milk river, the portion of it below a low summit in Sec. 19, Tp. 4, Rge. 16, W. 4th Mer., forming what is known as Verdigris coulee.

At a point in Sec. 9, Tp. 5, Rge. 17, W. of 4th Mer., the valley converges to a narrow section, and at this point surveys were made for a dam to impound the water. It is estimated from the surveys made that with a dam at this point and several embankments in Sec. 12 or 16, Tp. 5, Rge. 17, West of the 4th Mer., it will be possible to store from twenty to twenty-five thousand acre-feet, depending upon the height of the dam and embankments which may be found most feasible to build.

Verdigris Reservoir Site.—During the field season of 1914 a survey of Verdigris lake was only partially completed by Mr. Sutherland, when his party was called off the work. During 1915 Mr. Montague completed the survey.

This reservoir site is situated in Verdigris coulee, referred to above, and covers a portion of Tp. 3, Rges. 15 and 16, West of the 4th Mer., as well as a portion of Tp. 5, Rge. 16, West 4th Mer. It is probably the best site in which to store a large quantity of water, under the project. From the surveys made, it is estimated that it would be feasible to store at least 116,000 acre-feet of water at this site.

TOPOGRAPHIC SURVEYS.

As stated previously, a set of levels was carried over the township lines only in 1914, and a rough estimate of the irrigable areas made from this information. During 1915 it was endeavoured to fill in the townships, or portions of the townships, found to be irrigable, by running levels over the section lines throughout. This work was carried on in conjunction with the surveys for main canals to the various irrigable areas, in order that no time might be wasted in levelling over the areas above the canals and therefore non-irrigable.

Although the system of canals to tracts 7A, 7B, and 7C are very complicated, it is possible to deliver water to a large percentage of these tracts. It was estimated last year that some 91,000 acres of land in these tracts could be irrigated and, although the more detailed estimate now under way will not be completed for some time, it is believed that at least this amount of land will be found irrigable, although the cost per acre to irrigate some of it may be high.

PARTY NO. 11.

Mr. Sutherland assembled his party at Lethbridge about the middle of April and moved camp to Chin Coulee, Sec. 6, Tp. 9, Rge. 18, W. 4th Mer., and started his field work on April 21. From this camp a reconnaissance was made to determine the

storage possibilities of the lakes in Chin coulee, in Tps. 8 and 9, Ranges 17, 18 and 19, W. 4th Mer., and levels were run over all of the lands to the east of this coulee which could be conveniently reached from this camp.

CHIN COULEE RESERVOIR SITE.

In last year's report it was estimated that it would be necessary to store some 110,000 acre-feet of water in Chin coulee in order to supply the required amount of water to the lands directly under this reservoir. From the reconnaissance made it is believed that it will be feasible to store this amount of water. A further estimate of the irrigable land under this reservoir is being made so that, upon the completion of this, it will be possible to determine more accurately the quantity which it will be necessary to store at this site.

LEVELS.

Levels were run over the irrigable areas in conjunction with the surveys for the main canals throughout the various tracts in a similar manner to that of party No. 10. During the season Mr. Sutherland completed levels over tract 5A, 5B, and 6, including all of the irrigable land between the Belly river and Etzikom coulee north and south, and between Chin coulee and Range 10, West of the 4th Meridian, east and west.

An estimate of the irrigable areas in these tracts has not yet been completed, but it would seem that there would be less irrigable land in both tracts 5A and 6, and more irrigable land in tract 5B than estimated in last year's report.

In both tracts 5A and 6 there are some large areas which were found, upon completing the surveys this year for the main canals, to be above the canals and therefore probably non-irrigable. It may be possible to reach some of them, but the expense of constructing the necessary flumes may make the cost to irrigate them prohibitive. The land in these areas is good and it will be unfortunate if they are found to be so situated that water cannot be carried to them at reasonable cost.

HORSE FLY LAKE.

A survey was made of Horse Fly lake to determine the possibilities of storage. The depression is very shallow and, although a considerable amount of water could be stored there, the surface exposed to evaporation is very great in proportion to the quantity which could be stored and consequently the losses would be great.

It was thought that this lake had no natural outlet and, since a very large area of country drains into the lake, the surveys made were more for the purpose of determining the possibilities of draining the lake and finding out how much land would be flooded by turning irrigation water into it. It was found that although the drainage channel is not well defined and is very flat for a considerable distance out of the lake, it can be drained by cutting through from the northeast end into Purple Springs coulee.

CONCLUSION.

It should be remembered that the surveys made in 1915 were simply a continuation of the surveys started in 1914, and this report is necessarily a continuation, to some extent, of the reports previously submitted.

To be read intelligently the previous reports, which were accompanied by maps showing the locations of the various tracts of irrigable lands, should be referred to.

It has been decided to continue the office work in connection with this project throughout the coming year, in order to make as exhaustive a study as the information and staff available will permit. There are a great many alternative schemes possible in connection with this project, and it will only be after a great many estimates have been made that it will be possible to report definitely on the whole project.

MILK RIVER TRAVERSE.

One of the terms agreed upon, under the Waterways Treaty between Canada and the United States, is that the latter country shall be allowed to carry water from the St. Mary river through the Milk River channel in Canada; the United States to be held responsible for any damage which may be caused in the river valley, by the passage of this quantity of water.

In order to be in a position to determine the extent of any damage which might occur by the passage down the channel of this amount of water, it was thought advisable to make an accurate survey of the river channel to determine the exact conditions before any water was turned in from the St. Mary river.

A party was therefore organized under Mr. W. M. Edwards, D.L.S., and assembled at Cardston, Alberta, during the first week of July, 1915. The party was moved to the north fork of the Milk river near the boundary line, and field work started on the 5th July.

INSTRUCTIONS.

Since this is the first large stadia survey which has ever been undertaken by this department, the instructions issued may be interesting. The following are copied from the memorandum of instructions, prepared and issued by the Commissioner of Irrigation and approved by the Surveyor General of Canada:—

TRAVERSE OF RIVER BANKS.

1. "The traverse of the river shall be made in accordance with the regulations laid down in the Manual of Instructions for the survey of Dominion lands, and both banks of the river shall be accurately located.
2. "The traverse shall be a stadia traverse, that is to say: Both the courses and off-sets shall be measured by stadia method.
3. "The length of any course shall not exceed 600 feet, and off-sets shall not exceed 500 feet in length. Off-sets shall be observed to locate all determining points of change along both river banks, and shall be at an interval not greater than 100 feet along each bank. All distances shall be recorded in feet and tenths of a foot.
4. "The vertical angle in measuring any traverse course shall not exceed five degrees and horizontal distance shall be corrected for any vertical angle of two degrees or greater.
5. "For measuring off-sets, the vertical angle shall not exceed fifteen degrees and the horizontal distance shall be corrected for all vertical angles of five degrees or over.
6. "The traverse shall be accurately tied to Dominion Land Survey Monuments at least every three miles.
7. "The stadia off-set shots shall show the elevation as well as the location of the top of bank.
8. "The stadia traverse levels shall be corrected to agree with the regular level line, but separate levels shall be run by the stadia transit as a rough check on the level line.
9. "All permanent iron bench-marks set shall be accurately tied to the traverse survey line.
10. "Both banks of the main or any secondary channel as well as all islands shall be accurately located.
1. "The junction of all tributary watercourses shall be located and shown in the notes.

LEVELS.

1. "The datum of the level line shall be reduced to mean sea-level datum.
2. "The datum of elevation shall be gained from bench-mark No. 575 located in NE. $\frac{1}{4}$ Section 11, Township 1, Range 23, W. 4th Meridian, and the levels shall be checked by connecting with the permanent iron bench-marks which have been set by the irrigation surveys at Milk River station and at the south end of Pakowki lake.
3. "A permanent iron bench-mark shall be set at or near the crossing of every township line, and elevations shall be determined for all permanent iron bench-marks set by the Hydrographic Surveys Branch along the channel of the Milk river.
4. "The limit of error in the level line should not exceed .05 distance in miles, and if the error exceeds 0.1 distance in miles, the levels must be re-run and the error checked. The errors shall be determined by checking with the permanent iron bench-marks mentioned above.
5. "The elevation shall be determined for every traverse hub.
6. "An accurate cross-section of the river taken from bank to bank and extending at least fifty feet on each side shall be made every two miles of river meander, and every

cross-section must be accurately located from the traverse line. In determining the cross-sections elevation shall be gained at horizontal distance of not over five feet.

7. "Below Pakowki lake the levels must be checked by re-running each day's work, or else by running one check line from the eastern crossing to the last permanent iron bench-mark which was checked at Pakowki lake.

8. "A search shall be made for all bench-marks located by L. E. Fontaine, D.L.S., and wherever they are found their elevation must be noted.

NOTES AND SKETCHES FOR LAND CLASSIFICATION.

1. "The object of this part of the survey is to obtain by notes and sketches the agricultural value of any lands which may possibly be damaged or destroyed by erosion or overflowing on both sides of the river.

2. "Complete notes and sketches shall be made of all lands bordering on the river or other lands which by virtue of their elevation are liable to be eroded, destroyed or damaged by an extreme stage of flow in the river, or by it changing its course.

3. "All changes of the classification of lands must be noted and sketched in wherever necessary.

4. "The classification of the soil shall be as laid down in the Dominion Land Survey Manual and in addition to this all trees or other vegetable covering must be carefully noted, with an estimation of any commercial value they may have.

5. "All notes and sketches shall be referred to the traverse line.

6. "It is desirable that the notes should indicate the surface slope and distance from the river banks to the edge of the main valley hills at sufficiently frequent intervals, to indicate the average width of the river valley through every section of land.

7. "The accuracy and closeness of the details shall be in accordance with the liability of the land to damage.

PLAN.

1. "The plan shall be plotted to a scale of 400 feet to the inch on a continuous roll of paper.

2. "Two sets of field books shall be used, being taken out in the field on alternate days and the plan shall have all information gained, plotted up not later than one day after the information has been gained in the field. At the end of each week after having been O.K'd by the officer in charge, shall be inked in.

3. "Each cross-section of the river taken in the field shall be located on the plan and numbered with reference to the chainage on the traverse line.

4. "All sections shall be plotted on a continuous roll of cross-section paper numbered the same as on the plan and plotted to a scale of fifty feet to the inch horizontal and five feet to the inch vertical.

5. "Standard irrigation office conventional signs shall be used, unless these conflict with any instructions in the Dominion Land Survey Manual when the latter shall rule.

The above are the more important instructions issued for the execution of this work, and since these instructions were followed closely whenever possible, the method of carrying on this survey, and the accuracy aimed at, will be well understood from a perusal of them.

In regard to the plan, a scale of 400 feet to one inch was found to be too small a scale to show the information in sufficient detail, and the scale was changed to 200 feet to one inch.

It was found to be impossible for one draughtsman to keep the work plotted to date, as required under the instructions, and this was unfortunate, because the work was to some extent retarded on this account.

TRANSPORT.

Owing to the difficulty, and sometimes impossibility of getting down to the Milk river, whenever necessary, with teams, it was decided that the best means of transporting the party along the river would be by canoes, and Mr. Edwards was furnished with three large freight canoes, to which were added later in the season a small cedar skiff.

Considerable difficulty was found in moving camp with canoes along the north fork of the river. The river was altogether too shallow to float canoes under the loads found necessary to carry. In addition to the usual camp equipment, on account of the very wet and cold weather, it was necessary to carry heating stoves and coal, so that the canoes did not prove satisfactory on the upper stretches of the river.

As Milk River station was approached, a large portion of the equipment, not immediately required, was shipped into the storehouse there, and the move from middle of Range 20 to the town of Milk River was made in one trip of the canoes.

Another objection to the use of canoes only was that no means were provided for getting provisions to the camp, and Mr. Edwards, until a team and wagon was furnished him, had to depend altogether on outside sources which sometimes were not reliable, and consequently the party was often short of provisions.

PROGRESS OF THE WORK.

During the month of July, the progress of the work was not satisfactory, owing to a misunderstanding of the instructions. Mr. Edwards during this time was locating all of the topography by instrument, whereas it was considered only necessary to sketch the most of this, estimating distances and elevations mostly by eye. Although the method of using an instrument to locate the topography was of course very accurate, it made the progress very slow.

After the proper procedure had been explained, the progress of the work was better but it was soon evident that in order to complete the survey during the field season of 1915, still greater progress would have to be made by the party. Instructions were therefore issued to reorganize the party if necessary and increase it to such an extent that the work would be completed during the season.

By the addition of one rodman it was found possible to use two instruments on line, which greatly increased the speed of the work, and although along the lower part of the river valley the country became much rougher, the hours of daylight less, and progress otherwise retarded by the heavy growth of bush along the river, the survey was completed during the season.

TABLE I.—Stadia Traverse of Milk River. Showing work done at each camp.

Camp No.	Calendar week days.	Net days on line.	Total miles traverse line.	Total miles river meander.	Length of traverse as % of river meander.	Miles traverse line per calendar week day.	Miles river per calendar week day.	Miles traverse per net day on line.	Miles river per net day on line.	Remarks.
1.....	13	9	3.28	5.93	55	0.26	0.46	0.36	0.65	July 5 not included in net days on line.
2.....	10	8.25	8.13	12.59	65	0.81	1.26	0.99	1.53	
3.....	6	4.75	7.40	11.38	65	1.23	1.90	1.56	2.40	
4.....	4	2.25	3.09	4.43	70	0.77	1.11	1.37	1.97	
5.....	9	7.5	9.42	15.59	60	1.05	1.73	1.26	2.08	
6.....	9	7.25	14.65	20.38	72	1.63	2.26	2.02	2.81	
7.....	7	5	10.91	11.63	94	1.56	1.66	2.18	2.33	
8.....	7	5	12.73	15.32	83	1.82	2.19	2.55	3.06	
9.....	9	8	22.04	25.74	86	2.45	2.86	2.75	3.22	
10.....	10	7.75	19.21	20.68	93	1.92	2.07	2.48	2.67	
11.....	8	7	17.00	17.27	98	2.12	2.16	2.43	2.47	
12.....	10	9	17.26	18.33	94	1.73	1.83	1.92	2.04	
13.....	17	13	22.16	23.14	96	1.30	1.36	1.70	1.78	
14.....	9	9	13.79	14.66	94	1.53	1.63	1.53	1.63	
Totals...	128	102.75	181.07	217.07	83	1.41	1.70	1.76	2.11	November 29 not included in net days on line.

NOTE: Except the two dates noted in remarks net days on line includes all time on line; no deductions for side lines, section lines, cutting brush, etc. The mileage columns do not include any side lines or tie lines.

The following extract from Mr. Edwards' report will show in a general way the magnitude of the survey:—

"There were 1,706 courses in the main traverse line, which was 181 miles long. The length of river meander traversed was over 217 miles, exclusive of subsidiary channels of all kinds. The length of the traverse line from the initial point on the international boundary line to the most easterly crossing of the international boundary by traverse line is 180 miles and the length of the river meander between the same points is 216 miles. Cross-sections of the river channel were taken at 131 points. Ties were made to township surveys at forty-three points, of which six were along the international boundary."

The accompanying table compiled by Mr. Edwards shows the work done at each camp.

LETHBRIDGE NORTHERN IRRIGATION PROJECT.

REPORT OF V. MEEK, FIELD ENGINEER.

CALGARY, ALTA., March 30, 1916.

I have the honour to submit herewith my report on the progress of surveys on the Lethbridge Northern Irrigation project for the year 1915.

PREVIOUS REPORTS.

During the years 1913 and 1914 preliminary surveys were made to prove the feasibility of the scheme and in sufficient detail to approximately estimate the irrigable area and the cost of construction. A report on this work will be found in the annual report for the year ended March 31, 1915. This report estimates the total irrigable area at 101,000 acres and the approximate cost of construction at \$20.90 per irrigated acre. Before an irrigation district could be formed further surveys were considered necessary to more accurately classify the land and to furnish data for a more accurate estimate of cost. For this purpose it was decided to plane-table the whole irrigable area.

FIELD WORK.

Organization of Party.

A party of three plane-tables was organized in Lethbridge and consisted of the following men: Field engineer in charge of party, three assistant engineers, one draughtsman, six rodmen, three teamsters and one cook, with a camp and transport equipment of eight tents, two wagons, three democrats and ten horses.

This party commenced field work on April 29, and finished for the season on November 22, 1916, a period of 179 working days, covering 119,015 acres of topography, which is an average rate of 221 acres per plane-table day. No account was taken of a total of twenty-five working days which were lost during the season on account of bad weather.

When the reclassification work on the Canadian Pacific Railway Western Section was finished in September, 1916, a second party of three plane-tables was put on this work. This party commenced plane-tabling on September 17 and finished for the season on November 19, a period of fifty-five working days, covering 30,500 acres of topography at an average rate of 185 acres per plane-table day.

A total area of 149,515 acres was contoured during the season and in addition 315 miles of levels were run, setting bench-marks for the plane-table work.

Cost of Field Work.

Total cost of surveys for the season of 1915 is as follows:—

Wages of party for the field season.	\$ 8,852 31
Commissary (subsistence, fuel and cook's wages).	2,918 56
Horses (hay, oats and supplies).	619 00
Miscellaneous.	625 03
Draughtsman (4 months extra to finish plans).	300 00
Total cost.	\$13,314 90
Total area plane-tabled. acres.	149,515
Hence cost per acre is. cents.	8.9

Allowing a depreciation on outfit of \$1,500 for the season, the cost per acre plane-tabled would be approximately 10 cents.

PLANE-TABLING.

Each plane-table party consisted of an assistant engineer, two rodmen and a teamster, the teamster acting as recorder to the instrument man. The scale of the plans was 400 feet to one inch, allowing one section to be shown on each plan. Beginning with a measured base line at least 1,200 feet long, a closed plane-table survey was made of each section. The limit of error of closure allowed was one-twentieth of an inch in plan, which at the scale used equals 20 feet. The limit of error from plane-table levels on each section was two-tenths. All plane-table stations were secured by triangulation from the base line, as were also all mounds.

The greater part of the work was done by taking spot levels, over the whole area at distances apart varying from 100 to 400 feet, depending on the roughness of the land. The contours were then sketched on the plans in the field by interpolation. In giving the spot levels, care was taken to outline all sinks, knolls, drainage lines and saddles. All buildings, houses and fences were noted, also the character of the soil and the name of the owner of each parcel of land.

A reference bench-mark was placed on all wells and a note made of the elevation of the water level where it was possible to get it.

It was found that the work could be expedited considerably by setting up a level beside the plane-table at each station for reading elevations, using the plane-table alidade for stadia distance and direction only. This saves the time of the continuous adjustment of the alidade telescope, necessary to keep it in a level position.

LEVELS.

During the 1914 field season a system of stadia levels was run over the section lines of the irrigable area, and temporary bench-marks, consisting of wooden pegs, were driven into the mounds. Many of these temporary bench-marks could not be found the following year, so, for the plane-table work, a new set of levels was run over along the road allowances from the permanent iron bench-marks at the township corners. Temporary bench-marks for plane-table use were placed at half-mile intervals along lines two miles apart. Thus every section had bench-marks at the mounds on two of its sides. The limit of closure allowed for these levels was .05 in miles distance.

In order not to confuse previous plans and profiles, all levels were referred to the original datum, which was known as C.P.R. sea-level datum. The required equation to reduce any levels on this survey to the Government Geodetic sea-level datum is +11.02 feet.

SOIL TESTS.

During the past field season forty-one groups of soil samples were taken at typical points over the whole irrigable area, each group consisting of a series of four samples

from varying depths up to six feet. All samples were tested for alkali in the field with an electrical bridge, and a full discussion of the results is contained in a memorandum to the Commissioner by Mr. S. G. Porter, Assistant Chief Engineer, dated January 13, 1916. It is the intention during the field season of 1916 to make a much more extended soil survey of the whole project, in order to define any alkali areas which may be present.

SURVEYS STILL TO BE COMPLETED.

Commencing with the Turin district in the east, the topographic surveys have been finished as far west as Monarch, leaving the two districts of Rocky Coulee and Barons still to be completed. These two districts comprise an area of 120,000 acres, which could be contoured in seven months by a party of three plane-tables. The same party could also make the soil survey. Samples of soil to a depth of six feet, taken at points not more than two to three miles apart, should be tested for alkali. If any sample shows alkali in detrimental quantity, sufficient extra samples should be tested in that vicinity to accurately define the impregnated area.

In order to design and estimate the cost of the required headworks at Oldman river, it will be necessary to make a series of test borings at the dam site. Further borings should be made on the site of the two heavy cuts into and out of the reservoir at Keho lake. These borings will be required to a maximum depth of forty feet and those at the dam site to at least fifty feet, depending on the character of the ground encountered.

The party required for this work should be as follows: engineer in charge, head driller, assistant, teamster, and cook. Such a party should finish this work in from three to four months and, with the exception of the head driller, could be used for the balance of the field season, classifying the required excavation for the main canal. This should be done by digging test pits along the projected location to a depth of one or two feet below the grade of the canal bottom. These test pits should not be more than one mile apart, except where unusual conditions are encountered, when they should be dug at closer intervals.

A number of settlers owning bottom lands along the Belly and Little Bow rivers, adjacent to the Turin, Iron Springs and Monarch districts, have expressed a desire to have water delivered to their land for irrigation purposes. The difficulty of including these areas is the expense involved in dropping the water from the bench lands to the river bottom, a vertical distance of at least 200 feet. A reconnaissance of the amount of land available would show whether the cost of delivering water to these lands would be justified.

The owners of the proposed irrigable land in the Barons and Rocky Coulee districts are holding a meeting at an early date to decide definitely whether they wish to have their lands included in this project.* Should they decide not to irrigate, the system would need to be extended to include other lands, probably the tract south and east of Macleod, or, judging from the classification in the Turin and Iron Springs districts already completed, it is thought that the scheme would still be feasible with the Barons and Rocky Coulee districts excluded.

The following approximate estimate shows the basis of this assumption:—

	Acres.
Irrigable area in Townships 10, 11 and 12, Range 20, and Townships 11 and 12, Range 19, from 1915 estimate.	20,960
Irrigable area in the same townships from 1915 classification.	29,015

*NOTE.—The settlers in these districts subsequently decided that they did not want their lands included in the proposed irrigation district. Ed.

This shows an increase of 38.5 per cent over the 1915 estimate.

	Acres.
Total irrigable area, 1915 estimate.. . . .	101,000
Deduct area in Rocky Coulee and Barons districts.. . . .	35,000
Remainder.. . . .	66,000
Probable increase from plane-table classification 38.5 per cent of 66,000, or.. . . .	25,400
For a safe estimate, say.. . . .	20,000
Then the total irrigable area for the project, leaving out the Barons and Rocky Coulee districts, would be.. . . .	86,000

Allowing a duty of water of 1.5 acre-feet per irrigated acre, and an irrigation factor of 80 per cent, this area could be irrigated directly from Oldman river, eliminating the Keho Lake reservoir.

Total cost of reservoir, including inlet and outlet cuts.. . . .	\$250,000
Lateral system to serve 101,000—86,000-15,000 acres at \$5.. . . .	75,000
Total saving.. . . .	\$325,000
Cost of project 1915 estimate.. . . .	1,836,000
Less.. . . .	325,000
Engineering and contingencies at 15 per cent.. . . .	\$1,511,000
Total cost.. . . .	\$1,738,000
Cost per acre on the basis of 86,000 acres.. . . .	\$20 20

No allowance has been made for the saving in excavation for a main canal less capacity. This would probably be partly offset by the increased mean distance from the intake to the irrigable area.

OFFICE WORK.

In order to project the distributary system for the project, the topographic information on the section sheets was transferred to district maps on a scale of 2 feet to one inch. In order that these maps should be of convenient size, the irrigable area was divided into the following five districts: Turin, Iron Springs, Monarch, Rocky Coulee and Barons. The distributary system was first projected roughly on the district maps, and then located as accurately as possible on the topographic sectional sheets, showing the delivery elevation for each quarter-section parcel of land to be irrigated. The delivery elevation is to be in all cases not less than three-tenths of one foot below the weir elevation in the supply lateral, and less than six-tenths below the water surface grade in the supply lateral. Each section was then classified along the same general lines as the reclassification work on the Canadian Pacific Railway Western Section.

The classification was commenced in the Turin district at the eastern end of the project and this work is kept up with the canal projection so that each canal can be designed of sufficient capacity for the number of acres it serves.

The design of canal capacities was based on a memorandum to the Commission from Mr. Porter, dated December 22, 1915, on "Duty of Water Calculations and Canal Capacities." Mr. Porter in his calculations assumes a required minimum irrigation head of two and five-tenths second-feet, and a maximum requirement of 10 inches of water over fifty per cent of the irrigable area in fifteen days; this fixes the net capacity at one second-foot per 120 acres irrigated.

The gross capacity is calculated by adding for absorption losses six second-feet per million square feet of wetted area in loam and clay, and ten second-feet per million square feet of wetted area in sandy and gravelly soils.

While substantial progress has been made during the past winter a great deal of office work remains uncompleted and it is estimated that an office staff of three men will be required throughout the field season of 1916, in addition to the staff required to complete the field work.

REPORT OF R. J. BURLEY, INTERNATIONAL WATERWAYS ENGINEER,
FOR THE YEAR 1915.

OTTAWA, April 7, 1916.

I have the honour to submit herewith a brief review of the work upon which I have been engaged during the year ended March 31, 1916.

As during the previous year the greater part of my time was devoted to matters arising out of Article VI of the International Waterways Treaty in connection with the division of the waters of St. Mary and Milk rivers between Canada and the United States.

It developed at a conference held at Washington, D.C., in April, 1915, between the representatives of the United States and Canada that a radical difference of opinion existed between the two countries regarding the meaning to be placed upon certain words in this Article. The United States claim that only waters which cross the international boundary or which would cross the international boundary if not interfered with, are affected by Article VI, while the Canadian claim is that all the waters within the two river systems are affected.

The case was very fully argued before the International Joint Commission at St. Paul, May 24-28, and is still under consideration by that body.

STREAM ADMINISTRATION.

After the hearing at St. Paul work was resumed on the new system of water administration by which it is proposed to deal with applications for the use of water by drainage basins rather than by streams as has been the case in the past. It has been agreed by all who have had to deal with this question that the old system is fundamentally wrong in that it does not recognize the right of the prior appropriator, on the main stream of a drainage basin, to protection from subsequent appropriations on the tributaries of this main stream above him. Fortunately there has, so far, been no case in which this question has been raised and it is probable that there are few, if any, drainage basins which have been overgranted or within which the rights held on tributaries will be detrimental to prior rights lower down on the basins, so that the new system can be installed without interfering in any way with existing rights. The necessary forms and books were designed and have now been printed so that it is hoped that the new system can be put into operation in the near future.

INSPECTION TRIP.

A short time was spent in the field inspecting some of the canals diverting water from the Canadian tributaries of the Milk river, and practically all the schemes on the Lodge and Battle Creek drainage basins were examined with a view to obtaining a fairly close estimate of the area actually irrigated.

Owing to the heavy rainfall last summer and to the extreme drought of the preceding year it was found difficult to arrive at any very definite conclusion, but while it is apparent that there are some cases where irrigation is not being applied, I believe that a gradual improvement is taking place in the methods and means employed in the distribution of water. In a number of cases the irrigated land, or part of it, has been broken and seeded to alfalfa or cultivated grasses.

An inspection was also made of the Alberta Railway and Irrigation Company's Milk river canal and a rough estimate made of the cost of the repairs necessary to put it into working order again. It was found to have been damaged to a surprisingly small degree considering the number of years during which it has had little or no attention.

Early in November a short trip was made to New York to attend an executive session of the International Joint Commission and shortly after the New Year my headquarters were transferred to Ottawa.

IRRIGATION BRANCH.

LIST OF PUBLICATIONS.

Irrigation Reports—1906-7-8-9-11-12-13-14 and 15.

Stream Measurement Reports—1909 to 1914.

Bulletin No. 1—Irrigation in Saskatchewan and Alberta.

Bulletin No. 2—Alfalfa Culture.

Bulletin No. 3—Report on the Climatic and Soil Conditions in the Canadian Pacific Railway Company's Irrigation Project, Western Section, (near Calgary).

Bulletin No. 4—Duty of Water Experiments and Farm Demonstration Works.

Pamphlet—Address by Dr. J. G. Rutherford on "Inter-dependence of Farm and City."

Pamphlet—Address by Mr. Don H. Bark on "The Actual Problem that Confronts the Irrigator."

Pamphlet—Address by Mr. S. G. Porter on "The Practical Operation of Irrigation Works."

Annual Reports of the Proceedings of the Western Canada Irrigation Association, 1907 to 1914.

(Note: The Report for 1907 is issued as Appendix 'B' in the Annual Report on Irrigation for 1906 and 1907).

Report of the Proceedings of the 21st International Irrigation Congress held at Calgary, Alta, October, 1914.

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DEPARTMENT OF THE INTERIOR OF CANADA

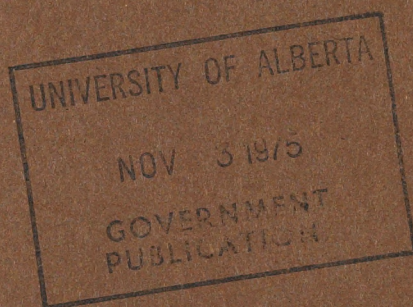
Hon. J. A. H. MCNICHE, Minister; W. W. CORY, Deputy Minister

in Charge of the Survey Branch---E. F. DRAKE, Superintendent.

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REPORT ON IRRIGATION SURVEYS AND INSPECTIONS

1916-17

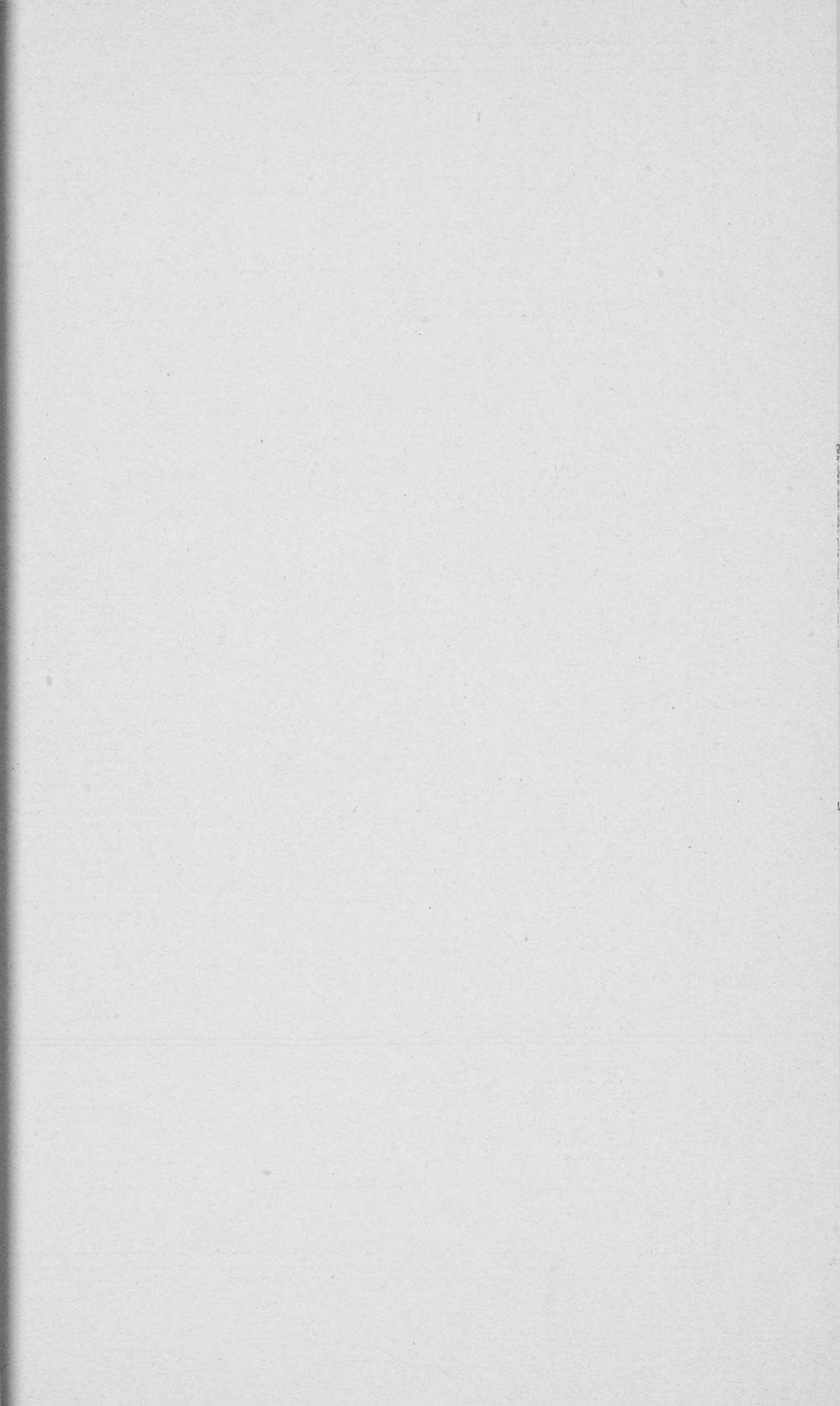


OTTAWA

J. DE LABROQUERIE TACHÉ

PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

1917



ROLL OF HONOUR

IRRIGATION BRANCH

DEPARTMENT OF THE INTERIOR.

Employees Enlisted for Active Service.

J. W. H. Wilkes	Leveller	Aug. 16, 1914	Lieut. 3rd Brig., R. H. A.
E. S. McMillan	Draughtsman	Aug. 21, 1914	L. Corp. Div'l Engineers
W. E. Dow	Draughtsman	Aug. 22, 1914	Bombing Instr., 13th M.D.
C. V. Craik	Engineer	Aug. 22, 1914	Corp. Div'l Engineers
E. S. Clifford	Hydro Asst.	Aug. 24, 1914	Maj. Asst. Provost Marshal
R. V. Muller	Leveller	Aug. 26, 1914	Tpr. Royal Can. Dragoons
C. E. Vrooman	Leveller	Sept. 26, 1914	Spr. Div'l Engineers
C. P. Maxted*	Rodman	Sept. 26, 1914	Spr. Div'l Engineers
H. E. Bowden	Teamster	Sept. 26, 1914	Lieut. Machine Gun Corps
J. S. Ferrier	Draughtsman	Nov. 6, 1914	Maj. Div'l Engineers
H. D. St. A. Smith	Engineer	Nov. 9, 1914	Capt. and Adj., 31st Battalion
C. B. Hornby†	Accountant	Nov. 16, 1914	Pte. Army Service Corps
G. N. Page	Leveller	Nov. 16, 1914	Q. M. S. Div'l Engineers
D. C. McDougall	Accountant	Nov. 19, 1914	Lieut. Provost Marshal's Staff
G. H. Nettleton	Hydro. Asst.	Jan. 4, 1915	Staff Sergt., 175th Bn., C.E.F.
N. J. Arnold	Draughtsman	Jan. 28, 1915	Lieut. R. N. Flying Corps
H. S. Kerby	Engineer	Feb. 11, 1915	Capt. Div'l Engineers
J. H. Jones	Engineer	Apr. 26, 1915	Pte. 53rd Battalion
E. W. W. Hughes	Engineer	May 8, 1915	Lieut. Signallers, Can. Engrs.
G. R. Elliott	Engineer	Aug. 16, 1915	Capt. 1st Pioneer Battalion
W. T. White†	Engineer	Aug. 16, 1915	Lieut. 4th University Co.
H. W. Cheney	Engineer	Sept. 29, 1915	Pte. 4th University Co.
N. R. English†	Rodman	Sept. --, 1915	Sergt. Maj., 87th Battalion
W. E. Hunter	Accountant	Oct. 2, 1915	Pte. 16th Batt., Can. Scottish
E. L. Hornby	Draughtsman	Oct. 12, 1915	Co. Q.M.S., 1st Pioneer Battalion
J. Cawthorn	Clerk	Oct. 14, 1915	Pte. 1st Pioneer Battalion
H. B. R. Thompson	Engineer	Nov. 8, 1915	2nd Lieut., Royal Engineers
F. R. Burfield	Engineer	Dec. 31, 1915	Pte. Army Medical Corps
W. G. Guthrie	Draughtsman	Feb. 20, 1916	Sergt. Australian Imp. Forces
L. E. M. Shenton	Draughtsman	Feb. 24, 1916	Lieut. Royal Flying Corps
W. B. Huteson	Engineer	Mar. 13, 1916	Lieut. Div'l Engineers
H. R. Carscallen	Engineer	Mar. 31, 1916	Sergt. Canadian Reserve Cycl.
W. R. McCaffrey	Engineer	Mar. 31, 1916	Spr. Div'l Engineers
R. E. Matheson	Hydro. Asst.	Mar. 31, 1916	Capt. and Adj. 4th Pioneer Bn.
P. J. Jennings	Office Engineer	Apr. 1, 1916	Lieut. Div'l Engineers
G. H. Whyte†	Divl. Hydro Eng.	Apr. 4, 1916	Pte. Army Medical Corps
T. H. Burt	Hydro Asst.	Apr. 4, 1916	Lieut. 4th Pioneer Battalion
R. H. Goodchild	Engineer	Apr. 22, 1916	Corp. 50th Queen's Battery
L. J. Gleeson	Engineer	May 9, 1916	Lieut. 8th Constr. Batt.
F. K. Beach	Engineer	May 21, 1916	Gunnr. 72nd Queen's Battery
J. M. Paul	Engineer	May 22, 1916	Gunnr. 67th O. S. Battery
O. H. Hoover	Engineer	June 15, 1916	Lieut. 25th Reserve Bn.
I. R. Strome	Engineer	June 20, 1916	Gunnr. 73rd Field Battery
J. A. Currie	Draughtsman	Aug. 1, 1916	Pte. Div'l Cyclists
G. C. McIntosh	Draughtsman	Aug. 19, 1916	Gunnr. 72nd Battery
A. C. Wimberley	Draughtsman	Sept. 1, 1916	Pte. 187th Battalion
R. J. Srigley	Hydro Asst.	Oct. 1, 1916	Pte. 239th Battalion
R. J. McGuinness	Engineer	Nov. 15, 1916	Pte. 211th Battalion
A. E. Hughes	Packer	Nov. --, 1916	Spr. Div'l Engineers
R. J. G. White	Chief Clerk	Dec. 1, 1916	Lieut. Tunnelling Co.
V. Meek	Engineer	Dec. 11, 1916	Lieut. Tunnelling Co.
T. M. Montague	Engineer	Dec. 11, 1916	Pte. Div'l Engineers
J. A. Telfer	Leveller	Jan. 1, 1917	Lieut. 78th Battery, C.F.A.
J. E. Caughey	Engineer	Mar. 1, 1917	Gunnr. 38th Siege Battery
E. J. Switzer	Engineer	Mar. 12, 1917	Pte. Can. Army Med. Corps
R. H. Waterhouse	Clerk	May 12, 1917	

*Died of wounds.

†Awarded Military Cross.

‡Killed in Action.

DEPARTMENT OF THE INTERIOR OF CANADA

Hon. W. J. ROCHE, Minister ; W. W. CORY, Deputy Minister

Irrigation Branch---E. F. DRAKE, Superintendent

REPORT ON
IRRIGATION SURVEYS
AND INSPECTIONS

1916-17

OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

1917

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IRRIGATION

REPORT OF THE SUPERINTENDENT.

Following the rule adopted last year this report of the Irrigation Branch for the year ended March 31, 1917, comprises brief reports by myself and by the Commissioner of Irrigation and Chief Engineer, under whose supervision much of the work was conducted.

The grain crop in southern Alberta and southwestern Saskatchewan—the district in which the principal interests of the Irrigation Branch are centred—was again good. The yield was, generally, not as high as in 1915, but was distinctly above the average, and in some districts equalled the record of 1915. This, coupled with the higher prices which obtained in 1916, made the crop of that year very profitable and many settlers who had suffered severely from crop failures prior to and during 1914 are now, as the result of two good harvests, on the high road to prosperity.

The exceptionally good grain crops in southern Alberta and southwestern Saskatchewan in the years 1915 and 1916 were due, primarily, to the unusually plentiful and well-distributed rainfall throughout the critical periods of the growing season, coupled with hot, dry weather during the ripening period in August, and to the absence of rust which so seriously affected the crops in other districts. The average precipitation at Calgary during the growing season for the 32-year period 1885-1916 was 13.5 inches, ranging from 6.8 inches in 1892 to 31.5 inches in 1902. The precipitation during this period, April to October, inclusive, during 1915, was 17.3 inches, and during 1916, 10.8 inches. While the latter is below the general average, the heavy rainfall of September and October, 1915, and April and May, 1916, more than compensated for the scanty precipitation during June and July of 1916. In this connection it is well to remember that the volume of rainfall is of less importance than its seasonal occurrence.

While an adequate and well distributed volume of moisture supplied naturally in the form of rain is undoubtedly more satisfactory than a similar amount supplied artificially by irrigation, the rainfall statistics and crop yields throughout this period clearly indicate the value of irrigation as a means of crop insurance, even in cases where it may not be required every year for the production of forage crops.

IRRIGATION DEVELOPMENT.

The practical completion of three of the larger irrigation projects, the discontinuance of work on others owing to the difficulty of securing funds, the falling-off in immigration, the shortage of man power and the high rate of wages for farm help have resulted in temporary stagnation in the development of irrigation enterprises.

The condition of the labour market is seriously interfering with ordinary farm work, and will probably result in a reduced acreage being planted in 1917. The effect upon irrigated farms is even more serious than in districts where irrigation is not practised. The irrigation farmer expects, and should receive, a greater return than his neighbour who practises ordinary farming methods, but in order to accomplish this he must make greater expenditures both of capital and labour. As both capital and labour are at present scarce and dear, the irrigation farmer finds it difficult, and in some cases quite impossible, to complete the construction of irrigation works or to maintain such works after construction, or to prepare his land so as to reap the return he should receive from the application of irrigation water. The result is that the larger completed projects are being settled and developed very slowly, while little

development work is being done on the smaller projects except in cases where the owner is himself able to do the work.

This is particularly regrettable at the present time when large areas of excellent land in the "dry belt" are awaiting the settler and the plough, and where irrigation works which have cost many millions of dollars are lying practically idle because of the falling-off in immigration, while at the same time there is greater need than ever before for increased agricultural production. This unfortunate condition will undoubtedly right itself in time, but meanwhile the land is unproductive and little or no return is being realized on the invested capital, while the maintenance expenses are almost as great as if the systems were being fully operated.

FIELD WORK.

In his report submitted herewith the Commissioner of Irrigation has described in some detail the nature and extent of the administrative and field work done during the past year. The work has been carried on under peculiarly difficult conditions. Many of our most experienced and efficient officers are absent on military duty—fifty-five having enlisted for overseas service and one being assigned to similar duty in Canada—and it is becoming increasingly difficult to keep the work up to its former standard of efficiency.

The necessity for economy has not been overlooked. All field survey work has been temporarily abandoned and a considerable saving has been effected by combining the work of stream measurement with irrigation inspections in certain districts. Although strongly urged to continue certain partially completed surveys—particularly in the district south and east of Lethbridge, Alta.,—with a view to finally determining the location and extent of areas that can be irrigated from the available sources of water supply, it has been decided not to prosecute this work further at present, although it is beyond question that its completion is essential to the fullest development of those districts. It may, however, safely be said that this work has by no means been abandoned; its completion has merely been deferred for a time.

HYDROMETRIC SURVEYS.

The work of hydrometric surveys (stream measurements) has been carried on much as in former years. Most of the gauging stations established in previous years have been maintained, and new ones have been established as opportunity offered. The policy has been to establish permanent stations on the more important streams and to continue measurements at these stations for an indefinite period. On the smaller streams, of less relative importance but still important in a limited sense, measurements will be continued for a period of approximately ten years from the date of the installation of the stations—a ten-year record being assumed to be sufficient for administrative purposes. In still other cases it has been found necessary in connection with local water supply problems to measure the flow of springs and small creeks at frequent intervals and with considerable exactness, but such measurements are rarely continued beyond a year or two, and are abandoned as soon as sufficient information has been obtained to serve the need of the case then being dealt with, which is usually the supply of water for domestic purposes for some village or settler.

The territory covered by this work is divided, for convenience of administration, into twelve districts, each in charge of an engineer, who, with one helper and the necessary gauge observers, performs all the field work. During the open-water season, 177 gauging stations were maintained, and records were also obtained at 138 gauges established on irrigation canals and ditches; during the winter season, 84 stations were maintained.

DRAINAGE.

The ownership and control of all sources of surface-water supply, including lakes, marshes and swamps, in the provinces of Alberta and Saskatchewan, and in that portion of the province of Manitoba added thereto by the Manitoba Boundaries Extension Act, 1912, are vested in the Crown in the right of Canada. (R.S.C. chap. 61.)

The unalienated public land within the boundaries of the provinces of Alberta, Saskatchewan and Manitoba is similarly owned and controlled by the Crown in the right of Canada, while control of the drainage of land is vested in the Crown in the right of the several provinces.

This divided jurisdiction has provoked controversy and has seriously interfered with the reclamation of submerged or swamp land and with the construction of highways, and has materially retarded the settlement and development of districts comprising large areas of such submerged or swamp land.

Efforts have from time to time been made, through informal conferences between representatives of the Dominion and Provincial Governments, to devise some mutually satisfactory and uniform means of dealing with the drainage of Dominion land, and at a conference held in Regina, Sask., in November, 1916, an agreement was reached with respect to:—

1. Small drainage projects to be dealt with by the Dominion Government;
2. Drainage of Dominion land in connection with the construction of highways by the Provincial Governments;
3. Drainage of Dominion land within the boundaries of drainage districts organized under Provincial Drainage Acts; and
4. Drainage projects initiated by the Dominion Government under the provisions of the Provincial Drainage Acts.

The result of this conference was reported by the conferees to their respective governments, with a recommendation that such legislation be enacted as might be required to give effect to the aforesaid agreement.

The Government of the province of Alberta subsequently signified its approval of the proposed methods of dealing with the several classes of drainage projects hereinbefore referred to, in accordance with the procedure agreed upon at the conference, and, as evidence thereof, submitted a draft of a Bill intituled "An Act respecting the Drainage of Dominion Lands," to be submitted for enactment by the legislature then in session, thereby giving effect to the agreement in so far as legislation is required by the province of Alberta.

Upon receipt of this draft Bill the Dominion Government, by an Order in Council dated 17th March, 1917, approved of the agreement and undertook, upon the enactment by the respective provincial legislatures, or any of them, of adequate legislation to give effect thereto, to approve and promulgate such regulations as may be required to carry the agreement into effect.

The Government of the province of Alberta duly passed "The Reclamation Act," and the Dominion regulations are now in course of preparation.

The agreement reached with respect to the several classes of drainage projects previously referred to is as follows:—

Small Drainage Projects.

Application is frequently made to the Dominion Government by owners of, or entrants for, fractional quarter-sections of land, the remaining portions of which are covered by the waters of lakes, or marshes, for permission to drain such bodies of water in order to reclaim the underlying land, which will thereafter be disposed of in one way or another (usually free of cost) to the applicants.

In other cases application is made for permission to drain such bodies of water and to purchase the underlying land.

It is usually found to be in the public interest that such small and shallow bodies of water should be drained, but in spite of the willingness of both the Dominion and Provincial Governments there has heretofore been no means of satisfactorily doing this except by following the procedure of the Private Ditches Acts of the Provinces of Alberta and Saskatchewan, or the Land Drainage Act of Manitoba, all of which provide unnecessarily elaborate machinery which is not well adapted to such small projects, although quite suitable to those somewhat more extensive.

The agreement hereunder provides a simple and satisfactory method of dealing with such projects and adequately provides for the maintenance of the drainage works after construction. Its adoption will be a boon to the settlers and a convenience to all the governments concerned—but chiefly to the Dominion.

(Agreement. Section 1.)

When application is made to the Dominion Government for permission to drain small lakes or swamps in order that the owners of, or entrants for, fractional quarter-sections of land thereby affected may be able to reclaim by drainage the submerged or swampy portions of such land and secure patent for the full area of each such quarter-section, or where application is made to the Dominion Government for permission to drain small lakes or swamps and to purchase the land to be thereby reclaimed, the applicants in such cases shall not be required to comply with the provisions of the Private Ditches Acts of the provinces of Alberta and Saskatchewan or the Manitoba Land Drainage Act, but upon production of evidence satisfactory to the Provincial Minister having control thereof that adequate provision has been made

(a) For the disposal of the water of such lakes or swamps;

(b) For the protection of roads, highways, and other public works;

(c) By agreement among the respective applicants for sharing the cost of constructing the proposed drainage works, and for the subsequent cost of maintenance;

and that the consent of the Dominion Government has been obtained, and upon submission to the said Provincial Minister of the report of the engineer appointed, or to be appointed, by the Minister of the Interior, the said Provincial Minister may approve of plans of the said proposed works, and the applicants shall thereupon become entitled to exercise all necessary powers respecting the expropriation of land required for right of way of the proposed works and for the settlement of the amount of damages with the owners of any lands affected thereby.

Provided, that the area to be reclaimed shall not in any one case exceed 1,280 acres and the estimated cost of the proposed works, as shown by plans thereof prepared by an engineer appointed or approved by the Minister of the Interior, shall not exceed the sum of \$2,000;

Provided, further, that any and all ditches or other works so constructed shall thereafter be maintained in the same manner and subject to the same conditions as are prescribed by Section 34 of the Alberta and Saskatchewan Private Ditches Acts, or in the province of Manitoba by Sections 45, 46, and 47 of the Manitoba Land Drainage Act, as if the said works had been constructed in accordance with the provisions of the said Acts.

Drainage in connection with Road Construction.

Considerable difficulty has been experienced by the Provincial Governments in constructing roads through the central and northern portions of the Prairie Provinces

and wide detours are often necessary to avoid shallow lakes or swamps. It has frequently been found that roads built at considerable expense are impassable for long periods and that the only practicable means of building good and durable roads is by first undertaking to drain bodies of water or vacant swamp land owned or controlled by the Dominion Government.

The Provincial Governments have not been willing to spend their limited revenues for works which would largely benefit vacant Dominion land, without receiving some financial assistance from the Dominion Government. The agreement provides for the sale to the provinces of a sufficient area of the land to be reclaimed by such works to pay for the cost of the drainage and road work, and further provides that the provinces shall sell the land so acquired at public auction, subject to settlement and to such further conditions as the Dominion Government may impose, and for the refund to the Dominion of any portion of the sale price after the cost of the works has been defrayed.

(Agreement. Section 2.)

When the Lieutenant Governor in Council deems it necessary in the public interest that any submerged or swampy Dominion land should be reclaimed by drainage in order to facilitate the construction or improvement of public highways through the district in which the said land is situated, and upon the consent of the Dominion Government having been obtained for the drainage of any bodies of water within the purview of the Irrigation Act, and for the construction of the proposed works on the said Dominion land, the Lieutenant Governor in Council may purchase from the Dominion Government any portion of the Dominion land to be so reclaimed. Any land so purchased shall be offered for sale by the Lieutenant Governor in Council at public auction, in accordance with such conditions as may be imposed by the Dominion Government, and the proceeds of the sale of the land shall be applied towards the cost of the said drainage and road work. Any surplus money remaining after the total cost of the work, including the purchase price of the land, shall have been repaid, shall be refunded to the Dominion Government;

Provided, that the expenses of the sale of the land and of the collection of the purchase price shall be considered as part of the cost of the said works;

And provided, further, that adequate provision shall be made by the province for the maintenance of the said works after construction.

The following action shall be taken by the province to give effect to the foregoing:—

1. An inspection and survey of the land; the laying out of the drainage ditches; the preparation of plans, with an estimate of cost and the proportionate benefit to each parcel of land affected, and the submission of such plans and estimate to the Dominion Government, with

2. An application to the Dominion Government to transfer to the province as much of the land affected by the works as may be necessary to fully cover the cost of the works.

Dominion Land within Organized Drainage Districts.

In many of the more northerly portions of the Prairie Provinces the arable land consists of ridges or islands interspersed with shallow lakes or swamps. Settlement is sparse because of the limited area of arable land and the difficulty of access to it at certain seasons.

The few resident owners are unable to drain their own lands because usually a comprehensive scheme of drainage is required, the cost of which is beyond their means. The bulk of the land in such districts, or certainly a goodly proportion of it, is vacant

Dominion land not assessable for any portion of the cost of the drainage works, although benefiting by such works equally with the land of resident owners.

(Agreement. Section 3.)

Where vacant Dominion land is included in a proposed drainage district and the province applies to the Dominion Government for the sale of such land to the province, and the Dominion Government agrees to sell the land, the Provincial Government shall be deemed to be qualified as a "resident owner" under the respective Provincial Drainage Acts.

The procedure required to give effect to the foregoing was agreed upon as follows:—

1. The province shall have an investigation made, in accordance with the provincial laws respecting drainage, and shall have a report and plans prepared, together with an estimate of the cost of the proposed works, the area and character of the land affected thereby, and the proportion of the cost to be assessed upon each parcel of land affected.

2. Such reports, plans, estimates of cost, and proportionate assessment shall be forwarded to the Minister of the Interior, together with a separate schedule of the Dominion land affected by the proposed works and the proportion of the cost of the works to be assessed upon each parcel thereof, with a request that the said land, or such portion thereof as may be available, be sold to the province in order to facilitate the organization of the drainage district and the undertaking of the necessary work.

3. If the plans of the proposed works and the estimated cost thereof are approved, the Minister of the Interior shall secure the approval of Council for the sale to the province of the available Dominion land affected by the proposed works, in accordance with the provisions of an agreement to be prepared under his direction and attached to the Order in Council. Such agreement shall contain, among other provisions, the following:—

- (a) The land shall be sold at the rate of \$1 per acre (or as may be agreed upon), payable as follows: Ten per cent of the purchase price shall be paid within thirty days of the execution of the agreement and the balance in nine equal, annual instalments, with interest at five per cent per annum upon the unpaid principal. Title to the said land shall remain in the Crown, in the right of Canada, until paid for in full, and title may then issue either to the province, or to its nominees, as may be requested by the provincial authorities. In the event of the province desiring to complete the purchase and take title to any part of the land sold before payment in full has been made for the whole tract, payment in full shall be made for such parcel or parcels, before letters patent are issued.

- (b) The land so sold to the province shall be offered for sale at public auction within a period of two years from the date of the completion of the works, or within such extended period as may be authorized by the Minister of the Interior for that purpose. The sale shall be made under regulations similar to those prescribed by the Minister of the Interior for the sale of School Lands, and the minister may be represented at such sales, if he so desires. It shall be a condition of all such sales that the purchaser shall build a habitable house upon the land purchased and shall go into residence thereon, or within nine miles of such land (or words to that effect to harmonize with Sub-section 2 of Section 28 of the Dominion Lands Act) within a specified period and shall reside continuously upon the land for a period of not less than six months in each of three successive years.

4. The organization of the drainage district shall then be completed in accordance with the provincial laws. In the event of failure to organize a

drainage district through the unwillingness of the resident owners, or for any other cause, the agreement for sale shall not be executed and the application submitted by the province for the purchase of the land shall be cancelled.

5. Any land which at the time of the organization of the drainage district is held under entry, but is un-patented, and which is subsequently abandoned by the entrant, shall not be liable for any portion of the cost of the works remaining unpaid at the date of the said abandonment. Such land shall, however, upon abandonment, be sold to the province at the same rate and subject to the same conditions as the land set out above, reserving to the entrant the right to his improvements; provided that if such land is subsequently sold by the province credit shall be given the purchaser for the amount of any drainage assessments paid by the previous owner or entrant and subject to any such assessments remaining unpaid at the date of the sale.

6. The proceeds of the sale by the province of land so acquired from the Dominion Government shall be applied by the province:—

(a) To recoup to the province any and all expenditures made in connection with the organization of the drainage district and the construction of the drainage works therein or in connection therewith, including the purchase price of the land, other than the proportionate cost assessed upon privately-owned land and remaining unpaid at that date;

(b) To cancel and remit the unpaid assessments charged against the aforesaid privately-owned land in the drainage district.

(c) To refund to the owners thereof any portion, or all, of the assessments previously paid on the said privately-owned land in the drainage district; and

(d) Any surplus remaining shall be applied towards the construction of roads and bridges in the rural municipality, or municipalities, in which the said drainage district is situated.

7. An account shall be kept by the Provincial Government of the proceeds of all sales of Dominion land acquired in connection with any drainage district, and of the disposition thereof, and a detailed statement thereof and of the expense incurred by the province in connection with each such district shall be rendered to the Dominion Government annually.

Drainage Projects Initiated by the Dominion Government under the provisions of Provincial Drainage Laws.

In certain cases where it is found to be in the public interest to drain shallow lakes or marshes, and where the adjacent lands have been alienated and are, for the most part, arable, the direct benefits of drainage accrue almost entirely to the submerged land which is owned by the Dominion. The settlers in the surrounding districts benefit only indirectly by the improved roads and more convenient routes of travel.

Under present conditions the Dominion Government cannot undertake the improvement of its own land without encountering serious legal difficulties, particularly in the expropriation of right of way for ditches, etc., and in making adequate provision for the maintenance of the works after construction.

Under the agreement the Dominion Government will be deemed a "resident owner" and will have the right to construct works for the reclamation of such land and to exercise all needful powers under the provisions of the Provincial Drainage Acts. In any case where such work is undertaken by the Dominion Government it is intended that the reclaimed land shall be sold at public auction and subject to settlement duties and that the proceeds of the sale shall be used to recoup to the Dominion Treasury the entire cost of the work. Dominion legislation may possibly be required before any such work is undertaken; certainly the money for the work must first be voted by Parliament, but the agreement removes any obstacles in so far as the Provincial Governments are concerned.

(Agreement. Section 4.)

When the Dominion Government, as the owner of vacant Dominion land requiring drainage, desires to reclaim such land in accordance with the provisions of the Provincial Drainage Laws, the Dominion Government shall be deemed to be qualified as a "resident owner" under the provisions of the respective Provincial Drainage Acts.

The provisions of the respective Provincial Drainage Acts shall be complied with by the Dominion Government in so far as the same may be applicable thereto; provided that:—

1. The inspection and survey to determine the feasibility of the proposed project, and the proportionate cost of construction works to be assessed upon each parcel of land affected thereby shall be made by an engineer appointed or assigned thereto by the Minister of the Interior, but the report of such engineer shall after having been approved by the Minister of the Interior, be dealt with in accordance with the provincial laws.

2. The whole cost of construction of such works shall be borne by the Dominion Government, and no debentures will be required in connection with any such drainage district. The proportion of the cost of the works assessed upon any land other than Dominion land comprised in any drainage district shall be collected annually, in the manner provided in the respective Provincial Drainage Acts, and deposited with the Provincial Treasurer, who shall, upon receipt thereof, promptly remit the amount so collected to the Minister of the Interior, to be applied in reduction of the expenditure made by him for the construction of the works. The Dominion land shall be offered for sale at public auction within a reasonable time after the completion of the drainage works, and the said land shall be sold subject, among other things, to settlement conditions, and upon the further condition that the purchasers of the said land shall be responsible for the maintenance of the drainage works in accordance with the provisions of the provincial laws and in accordance with the proportion of cost fixed by the engineer at the time of the organization of the district.

While as previously stated, the Government of the province of Alberta has enacted legislation to carry this agreement into full effect, the Saskatchewan Government has only partially done so by an amendment to the "Highways Act," passed at the last session of the legislature. This legislation deals only with such drainage of Dominion land as may be found necessary in connection with the construction or maintenance of highways. It is to be hoped that the further legislation required to give full effect to the agreement will be enacted at the next session. No action has been taken by the Manitoba Government to confirm, or otherwise, the agreement reached by the conferees.

Two small reclamation projects have been authorized in the province of Alberta under the provisions of this agreement.

1. Mr. John Hedberg has been permitted to purchase at one dollar per acre the NW. $\frac{1}{4}$ of section 6, township 54, range 16, and the NE. $\frac{1}{4}$ of section 1, township 54, range 17, west of the 5th meridian, for reclamation by drainage, comprising an area of some 317 acres.

About 75 per cent of this land is composed of muskeg covered with small brush and under water. In its present condition it is valueless but when reclaimed and cleared will be valuable as hay and agricultural land. The land can be effectively drained into Edson creek, which will provide a sufficient outlet.

2. Mr. N. J. Bailey has been permitted to purchase at one dollar per acre an area of some 798 acres for reclamation by drainage in township 53, range 3, west of the 5th meridian, portions of which are covered by the waters of a shallow muskeg lake.

The lands at present are worthless but when reclaimed will be valuable for agricultural purposes and can be drained into the North Saskatchewan river through an intermediate creek system.

Preliminary surveys will be made during the season of 1917 to determine the feasibility and probable cost of a large reclamation project. This project comprises a large but useless lake and several smaller lakes and marshes, all situated within a well-settled mixed-farming district and within convenient distance of good market towns and railways. These bodies of water apparently serve no useful purpose, except as a resort for wild fowl, and constitute a serious obstacle to the further development of an otherwise prosperous farming district.

PERSONNEL.

The "Honour Roll" of the Irrigation Branch now contains the names of fifty-six officials who have enlisted for active service. Charles P. Maxted died of wounds; Nelson R. English, who had previously been reported wounded and missing, was, on 16th April, 1917, officially reported as having died on or since 15th September, 1916; several have been wounded, some seriously; Lieut. W. T. White was awarded the Military Cross, and several others have won promotion for service in the field.

The honour roll is now closed; the names of any who may hereafter enlist under any other than the voluntary system must be recorded separately. It is believed, however, that but few of the remaining officials of this branch are eligible for military service.

REVENUE.

Appended hereto is a statement of the revenue received and accounted for during the year ended 31st March, 1917.

Lethbridge agency.. . . .	\$ 59 65
Calgary Agency.. . . .	1,356 35
Medicine Hat.. . . .	6,158 25
Swift Current.. . . .	1,199 40
Maple Creek.. . . .	3,753 26
Irrigation Branch, Calgary.. . . .	957 13
" " Ottawa.. . . .	1,897 18
	<hr/>
	\$15,381 22

which is made up as follows:—

Land sales.. . . .	\$14,310 51
Reservoir leases.. . . .	81 58
License fees.. . . .	576 00
Registration fees.. . . .	19 00
Preparation of plans.. . . .	394 13
	<hr/>
	\$15,381 22

E. F. DRAKE,

Superintendent of Irrigation.

REPORT ON IRRIGATION AND CANADIAN IRRIGATION SURVEYS.

BY F. H. PETERS, COMMISSIONER OF IRRIGATION AND CHIEF ENGINEER.

In submitting this annual report attention is directed to the radical change in the form of submission that has been made. In an endeavour to condense the report as much as possible and submit only such matter as is necessary for record, all the subject matter has been dealt with in one summary report. No original reports are

submitted, but as a matter of record the names of all engineers in charge of any important part of the work have been mentioned. All efforts to prepare the report in an attractive manner have been sacrificed to the direct scheduling of the more important features of the work in brief form.

ORGANIZATION OF STAFF.

The organization of the staff was similar to last year, except that the proportion employed in the office was somewhat greater. This was caused by the fact that all field work was cut down to the necessary administration work, and no large survey work was undertaken except that necessary to finally complete all field information concerning the Lethbridge Northern Project. At the same time, owing to the necessity of completing estimates on certain large projects formerly developed in the field, the office engineering staff had to be somewhat increased.

A change in the office procedure was made with a view to placing the Assistant Chief Engineer in a position entailing more direct supervision over all matters of a technical engineering character. This meant that in addition to the work in connection with the large irrigation companies, all work passing through the office engineers' hands and all the office work in compiling the reports on the surveys of the large irrigation projects, was directly supervised by him.

It was again necessary to make a considerable number of changes in the personnel of the staff owing to men going on active service, but owing to the loyal support of the men remaining it has been possible to carry on the work efficiently and economically. The total number of employees on the permanent office staff was thirty and on the permanent field staff twenty-nine. This gives a grand total of permanent officers of fifty-nine, and including the summer assistants one hundred and four. Owing to the fact that we now have hydrometric records over a fairly long period and that the major portion of the irrigation construction work has been completed, it is planned next year to increase the efficiency and economy of the work in a number of districts by combining irrigation and hydrometric work. Under this new programme the efforts of the inspecting engineers will be, as fully as possible, concentrated on the development of actual field preparation and irrigation.

OFFICE WORK.

The office work carried out is indicated by the schedule below, which is given in a similar form to previous years for purposes of comparison.

Letters received..	13,032
Letters sent..	18,035
Applications for water rights recorded	52
Plans examined and approved..	176
Plans amended..	145
Agreements, right of way, etc., recorded..	45
Right of way plans recorded in quadruplicate..	20
Water agreements filed in quadruplicate..	616
Water agreements cancelled..	619
Water agreements transferred..	148
Notices for publication prepared..	34
Plans prepared..	598
Blue prints made..	13,950
Certificates issued under Section 20..	53
Certificates issued under Section 33..	47
Licenses recorded, in triplicate..	64
Weekly reports received from engineers..	2,003
Reports of discharge measurements received..	3,137
Reports of gauge heights received..	7,855
Descriptions of regular gauging stations, Form H. 1..	55
Reports of changes at river stations, Form H. 22..	310

STREAM ADMINISTRATION.

During the year a good deal of correspondence developed in connection with transferring the stream administration and records to the new system now being adopted and one office engineer was employed entirely on this work. Owing to the fact that it was impossible to make available for this very important work more than one engineer, that a great many details had to be studied and the details of the new system worked out, the progress of the work was not entirely satisfactory. However, a very considerable amount of necessary preparatory work was done, as scheduled hereunder, and it is expected that during the coming year the major portion of all the records will be transferred. Drainage basin administration maps have been prepared covering the first thirty-two townships from the British Columbia boundary to the 5th meridian and twenty-four townships from the 5th meridian to the east boundary of the province of Saskatchewan. Schedules of applications and licenses have been prepared for thirteen drainage basins, detail sheets for seven and balance sheets for five. Hydrographs and duration of flow curves have been prepared for fourteen stations.

HYDROMETRIC SURVEYS.

The records of this very important branch of the work are published in a separate report on hydrometric surveys. The organization of the work was similar to that of previous seasons. As noted under the caption "Organization of Staff," it is expected next year to combine certain parts of this work with irrigation inspections in order to gain further economy and efficiency. The office staff, including the chief hydrometric engineer, comprised seven men all told. The territory covered was divided into twelve districts and twelve hydrometric engineers were employed in the field. During the open water season, records were taken at 177 regular gauging stations on streams in Alberta and Saskatchewan and at 138 regular gauging stations on irrigation canals and ditches. Winter records extending as far north as the Peace river were secured at 84 regular gauging stations covering practically all the important streams in the two provinces.

The rating station was operated as usual and a total of 69 meters rated as below:—

Irrigation branch..	45
British Columbia hydrometric survey..	10
Manitoba hydrometric survey..	9
Canadian Pacific Railway Company, Department of natural resources..	3
Shawinigan Water and Power Company..	2
	<hr/>
	69
	<hr/>

FIELD WORK.

It has been the endeavour hereunder to describe very briefly all the field administrative work that was carried on. In the case of the duty of water determination work the forming of sound and considered opinion depends on the consideration of a great mass of detail, so that it is particularly difficult to summarize this data.

CYPRESS HILLS DISTRICT.

IRRIGATION INSPECTIONS.

In view of the fact that the bulk of the construction work had been completed in this district by 1915, it was no longer considered necessary to provide so fully for the inspection of the irrigation schemes. The old eastern and western districts were, therefore, combined and the whole territory covered by one party under the charge of Mr. M. H. French. The party took the field on April 29th and disbanded on September 27th. Mr. French and his assistant completed all the necessary inspections by November 13th. The season comprised 174 actual working days. The total number of inspections made was 184, the number of schemes surveyed was 8, and in addition to this, right of way surveys were made for 12 schemes; the number of miles travelled by team was 2,989. The party consisted of 5 men with 7 horses.

Mr. French reports in an interesting manner upon the general status of irrigation in this district as follows:—

"The construction work, tending to carry the unlicensed schemes further towards completion, and for the repairing of damaged structures, was practically nil this year. This is accounted for by the high price and scarcity of labour, owing to the agricultural districts being depleted of able bodied men, who have enlisted in the army. The farm help now available is decidedly unskilled and far from satisfactory, yet, the men demand big wages, being aware that the irrigator has no option. Consequently, the latter must choose between paying big wages to incompetent and unreliable help, or leave the work undone. Generally speaking, the latter course is followed with the plea of no help available.

"This is one of the unfortunate results of the present war. The patience and perseverance of the farmer and rancher is now being taxed to the uttermost to obtain and keep sufficient help to perform the barest essentials of farming and ranching operations. Fence repairs, summer fallowing and other needful work is being neglected for the lack of help. This forced economy of labour is reacting in a decrease and curtailment of the products of the farm, resulting in an increase in the cost of living and a decrease of the supplies available for the army. Recognizing that the paramount duty of the farmer or rancher to the Empire during the present crisis is the production of foodstuffs, the department should give every consideration to those persons who are concentrating their manpower and financial resources to that end and temporarily neglecting the repair or construction of irrigation works.

"The present year has completed the second decade of active irrigation development in the Cypress hills. This period has witnessed the progress of irrigation from the watering of a few acres to the construction of works necessary for the irrigation of about 64,000 acres. Surely, this is a record of which any district may be proud, since this achievement represents not the investment of outside capital, but the expenditure of hard labour and honest toil by stockmen and farmers. However, they must not now think of resting upon their hard earned laurels and allowing everything to fall into a state of disrepair or revert to its primitive state. They must realize that the task has but fairly begun, for there is much work yet to be done to bring the irrigated lands to the point of their fullest development and that henceforth progress will apparently be slow.

"One reason for this early development is the liberality of a beneficent Government. I refer to its excellent irrigation laws. In no part of the Empire has there been given more favourable opportunity for the settlers to improve their own welfare and develop the country than in the irrigated districts of the West. Possibly the spirit of the Irrigation Act has been somewhat violated, and made subservient to other motives than that of endeavouring to increase the productivity of land by bona fide irrigation, yet it is well to note that this has been largely eliminated in recent years and it should not be allowed to detract in any way from the belief in the ultimate need and usefulness of irrigation to the country. Irrigation has been tried in the face of bitter and costly experience and not found wanting. It fills a place in western agriculture of supreme importance; and its final development only awaits a more complete settlement of the country and rise of land values. The broad, fenceless prairie, where stock roamed at will, is now a thing of the past; and must, in so far as it is possible, be replaced by the extensive growing of forage crops upon the irrigated lands. This is the true sphere of irrigation in the prairie provinces."

Calgary District—Irrigation Inspections.—The work was confined to the same district as in the previous year, but the difficulty of transportation, owing to the very heavy roads, due to the wet season, again hampered the work considerably. The work was carried out by Mr. J. C. Milligan, who had one assistant and one team of horses. The work was commenced on April 19, and ended on October 26. The season comprised 140 actual working days. The total number of schemes inspected was 137, the number of schemes surveyed was three. The number of miles travelled by team was 1,883, and by train 630.

Practically no construction work was attempted this year and only one scheme was recommended for license. The reason for this was the great scarcity of labour occasioned by the war, and the very wet weather. Financial matters have improved among the ranchers and farmers, owing to the high prices which have been prevalent, and if labour conditions were normal, construction work could all be completed. Five new schemes have been authorized but as yet no work has been done on them, and eight new schemes have been authorized but only partially completed.

Special Inspections—Domestic, Municipal, Irrigation and Industrial.—This work was carried on under the immediate supervision of Mr. W. E. G. Hall, the office engineer. The routine work of the office engineer consisted mainly of examining and checking all plans, prepared by the inspecting engineers, or submitted by applicants for water rights or other purposes. In addition to this the office engineer supervised the work of the two special inspectors, and saw that for each trip the inspections were properly grouped, as regards economy in time, travel, expense and the urgency of an early report.

Mr. C. Chambers carried out the inspections in Alberta, totalling 66 in number, and made seven surveys of all descriptions. He travelled 6,254 miles by train and 1,586 miles by team or other means.

Mr. E. L. Miles carried out the inspections in Saskatchewan, totalling 91 in number, and made 19 surveys of all descriptions. He travelled 7,965 miles by train and 2,326 miles by team or other means.

The office engineer examined and checked 321 plans of all descriptions and 55 descriptions for right of way.

LARGE IRRIGATION PROJECTS.

Mr. Sam G. Porter, Assistant Chief Engineer, has submitted the summary reports which follow, on the Macleod Project, the Taber Irrigation District, the Lethbridge Northern Irrigation Project, the Milk and St. Mary Rivers Irrigation Project, and the Canadian Pacific Railway Eastern Section; and notes on the Canadian Pacific Railway Western Section, the Alberta Railway and Irrigation Company, and the Southern Alberta Land Company.

THE MACLEOD PROJECT.

In 1915 the President of the Board of Trade at Lethbridge made enquiries of this department as to the feasibility of irrigating a strip of land east of Macleod, lying between the Belly and Oldman rivers in the vicinity of Peace and Orton. This enquiry was afterwards supplemented by a petition signed by a number of the owners of land in the district asking the Government to make surveys to determine whether or not their lands could be irrigated at a reasonable cost.

Water Supply.—The water required to irrigate this land would be diverted from the Oldman river. The proposed dam, headworks, and a portion of the main canal of the Lethbridge Northern Project would be utilized, the new district bearing a pro rata portion of the cost of these works.

Reconnaissance.—The first definite steps towards the investigation of the feasibility of the project were taken in the late summer of 1915 when the Commissioner of Irrigation, accompanied by Mr. B. Russell, made a reconnaissance of the district, their investigation indicated that the land was suitable for irrigation with respect both to soil and topographical conditions. They estimated the irrigable area at 25,000 acres, but stated that because of the peculiar topographical features of the district a more detailed survey would be necessary to acquire accurate information.

Field Work, 1916.—Further surveys, therefore, were carried out during the season of 1916 to determine more accurately the location of the main and secondary canals, the amount of irrigable land and the cost per acre for the proposed development.

The field work was in charge of Mr. T. M. Montague. His party consisted of three assistant engineers, a draughtsman, six rodmen, four teamsters and a cook.

Camp was established April 25, 1916, field work started April 27th and was completed June 1st, covering a period of five weeks.

The following detail description of the project is abstracted mainly from Mr. Montague's reports.

Location of Main Canal.—The location of the proposed main canal for this district branches from the proposed location of the main canal for the Lethbridge Northern Project at the point on the south side of the Oldman river where the location of that canal turns across the river to the north bank. This point is on the Peigan Indian reserve about two miles west of its eastern boundary.

The location from the point of diversion to the eastern boundary of the Indian reserve follows a very steep side hill, which in one place becomes so steep that a flume would be necessary to carry the canal across a bluff. At the eastern boundary of the reserve in section 36, township 8, range 26, west of the 4th meridian, the banks of the river become too steep for canal construction and the location is, therefore, forced back from the bank into a heavy cutting which has a maximum depth of twenty-three feet and is a mile in length. On emerging from this cutting the location runs in an easterly direction and crosses the Canadian Pacific railroad in section 32, township 8, range 26, west of the 4th meridian. Advantage is taken of a gap through a ridge in section 34, township 8, range 26, west of the 4th meridian, and the location turns south for a short distance and then continues east again to section 19, township 8, range 25, west of the 4th meridian. At this point the land falls away to the north and east and as a consequence the location is dropped to the level of the lower plain. This is the end of the main canal, the extension of it from here being a secondary canal.

Lateral System—"B" Lateral.—This lateral is the continuance of the main canal described above. After crossing two coulees the location continues eastward as far as section 36, township 8, range 25, west of the 4th meridian. Here it turns in a northerly direction, but due to the country rising the location was forced westward to the Oldman river and as a consequence this portion north of section 36, township 8, range 25, west of the 4th meridian, was ultimately abandoned.

A branch location running east from section 36, township 8, range 25, west of the 4th meridian, was also developed, but as this soon encountered high land and cut banks along the Belly river, was also abandoned.

"A" Lateral.—This lateral is diverted from the main canal in section 34, township 8, range 26, west of the 4th meridian, and runs in an easterly direction along the side of a flat ridge, and is capable of irrigating the land on either slope of the ridge.

Levels.—The whole district was blocked out in one mile squares by levels run along the section lines and from these level notes contour maps were plotted of the area. A study of these maps showed that the topographical features of the district are peculiar and irregular and that the irrigable area is smaller than had hitherto been estimated.

Topographical Features.—The topographical features of this district are not such as might be expected on a tract of land lying as it does between two rivers. The land in townships 8 and 9, range 26, west of the 4th meridian, slopes fairly evenly to the north and contains a considerable acreage which can be irrigated. Further east the country is cut by a coulee which heads somewhere north of section 19, township 8, range 25, west of the 4th meridian, and after running a short distance south, turns east to the Belly river through the upper part of township 8, range 25, west of the 4th meridian. The land to the south of this coulee is rough and non-irrigable. The land to the north is smooth and irrigable but in place of draining directly into the coulee drains away from it. The divide occurs at the top of the coulee bank on the north side.

A ridge which forms the general divide between the Belly and Oldman rivers runs north from this coulee along the west boundary of township 9, range 24, west of the

IRRIGATION BRANCH

GENERAL PLAN

SHE WING

PRELIMINARY SURVEYS

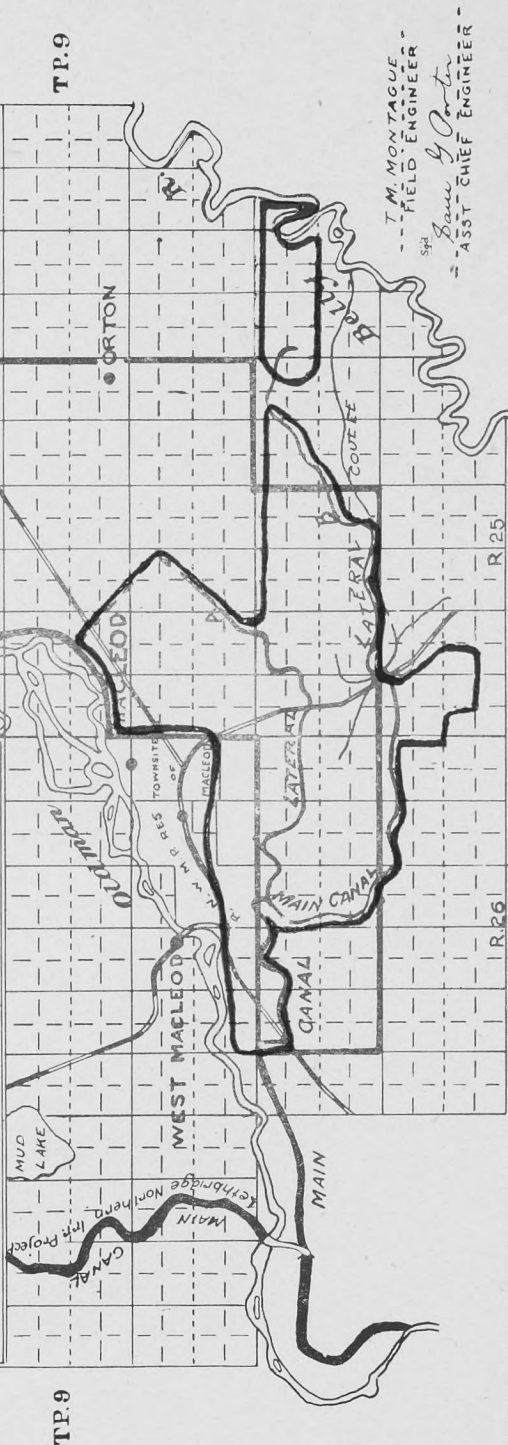
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MACLEOD IRRIGATION PROJECT

1916

SCALE - 2 MILES = 1 INCH

Irrigable area shewn thus
Area levelled over



T. M. MONTAGUE
FIELD ENGINEER
Sgt
James G. Porter
ASST CHIEF ENGINEER

4th meridian. This ridge is very flat, especially on the western slope and unfortunately rises slightly to the north, at the same time spreading out like a fan, the edge of which encounters the Oldman river in section 20, township 9, range 25, west of the 4th meridian.

It was thus found that, on account of the wide flat depression extending from one river to the other southeast of Macleod, the bulk of the land in the vicinity of Orton and Pearce could not be brought under the ditch. On the eastern slope of the ridge the canal location was forced into the breaks of the Belly river. On the western slope the land is rolling and the general slope very slight. Hollows which cannot be drained and large knolls which cannot be commanded form the greater part of it. The irrigable area, therefore, north of township 8, is so limited that the construction of "B" lateral north of the township line is not justified.

In township 8, range 24, west of the 4th meridian, there is a large flat or bottom along the Belly river. A portion of this is already irrigated by a private scheme from the Belly river. The remainder can be irrigated by carrying a canal across the ridge in section 36, township 8, range 25, west of the 4th meridian, and dropping it down to an elevation which would command the land.

Soil.—The soil in this district is suitable for irrigation. The surface soil in general is a light sandy loam with a fairly open subsoil. The exceedingly high winds which are prevalent in this part of the country tend to blow the land badly when it is dry. Tests of soil taken from different parts of the tract showed that there is insufficient alkali in the soil to ever form an obstacle to irrigation.

Area.—A careful inspection of the ground and a study of the levels and contour sheets indicate that there are about 9,500 acres of irrigable land in the district, made up as follows:—

Tp. 8, Rge. 24	900 acres.
" 8, " 25	3,000 "
" 8, " 26	2,500 "
" 9, " 25	2,200 "
" 9, " 26	900 "
<hr/>	
Total	9,500 "

These figures are the result, it must be understood, of a careful estimate but not an exact survey. It is possible that a detail survey will increase the irrigable area, especially if drainage be provided for a number of depressions which have no natural drainage outlets, and were consequently called non-irrigable.

Cost.—The following is a summary of the estimate of the cost of the project, based on the preliminary surveys as described above:—

Main canal.	\$94,000 00
" A " lateral.	15,000 00
" B " lateral.	12,000 00
Portion of cost of headworks and main canal, Lethbridge	
Northern Project at \$2 per acre.	19,000 00
Drainage at \$1 per acre.	9,500 00
Distribution system at \$5 per acre.	47,500 00
	<hr/>
	\$197,000 00
Add for engineering and contingencies, say.	31,000 00
	<hr/>
	\$228,000 00

Irrigable area 9,500 acres.

Cost per acre. \$24 00

The above estimate includes all necessary structures such as flumes, drops, bridges and turnouts.

THE TABER IRRIGATION DISTRICT**

In 1915 the province of Alberta enacted the Irrigation District Act, providing for the formation of districts whereby settlers may raise money by the sale of bonds secured by their lands for the purpose of constructing irrigation works.

The same year the farmers between Chin coulee and Taber, along the Crows Nest branch of the Canadian Pacific railway, erected the Taber irrigation district, for the purpose of entering into an agreement with the Canadian Pacific Railway Company, for the supply of water for the district from a reservoir already constructed by the Company in Chin coulee. The surveys were made by the Canadian Pacific Railway Company, and during the fall of 1915 a complete inspection and classification of the lands were made by the department.

It was found however, that a large area in the west end of the district had not yet passed to the ownership of the settlers who had made application to purchase it from the School Lands Branch. It could not, therefore, be bonded under the Irrigation District Act without the consent of the Dominion Government.

Efforts were made to secure legislation which would overcome the difficulties, but no solution was found which was mutually satisfactory to the Dominion Government as trustee of the School Endowment Fund, and to the Canadian Pacific Railway Company, which was to accept the bonds of the district in payment for the construction of the system.

Proposed Extension of the District.—It was then proposed to extend the limits of the district eastward to include an additional area sufficient to bring the total irrigable area in the extended district, exclusive of the school lands, up to the amount for which a water supply was available, viz., 17,000 acres. This department was appealed to, to make the additional surveys which were necessary for this purpose.

Field Work, 1916.—Complying with this request instructions were given to Mr. T. M. Montague to move his survey party to Taber.

A canal line to serve the proposed extension was surveyed, starting at a point on the canal as located by the Canadian Pacific Railway Company in section 30, township 9, range 16, west of the 4th meridian, and extending in an easterly direction to the eastern limit of the extension in section 30, township 9, range 15, west of the 4th meridian.

A plane table survey was then made of the tract between the projected line and the railroad, extending five miles east of the old limits of the district. Twenty sections or parts of sections were included, containing an area of 9,500 acres. A classification was made and checked in the field which showed an irrigable area of 6,778 acres, which was more than sufficient to bring the total irrigable area, exclusive of the school lands, up to the required 17,000 acres.

The field work was started July 26, and completed August 10.

Castle River Reservoir Site.—It was mentioned in Mr. Russell's report last year that a reconnaissance had been made of a reservoir site on the Castle river, and that further investigations would be undertaken to determine the feasibility of its construction.

Accordingly Mr. Russell was instructed to make a preliminary instrumental survey of the site. The proposed dam site is on the Castle river, in section 30, township 6, range 2, west of the 5th meridian. The estimated cost of an earth dam 105 feet high with an overflow spillway cut through the hill adjacent to but not connected with the dam is about \$200,000. The area of the reservoir at full supply level is 756 acres; the capacity of the reservoir 29,000 acre-feet. This gives an estimated cost of \$7 per acre-foot of storage which is a reasonable cost.

*For a fuller account of the earlier proceedings see the report of the Superintendent of Irrigation for 1915-16.

The records of the hydrometric office show that there is an approximate drainage area above the reservoir site of 270 square miles, and a mean annual run-off of more than 400,000 acre-feet.

Our present plans for the development of the Lethbridge Northern Project do not require the construction of this reservoir. It is possible however, that further development along the Oldman river may call for its construction at some future time.

THE LETHBRIDGE NORTHERN IRRIGATION PROJECT.

The investigation of the feasibility of irrigating certain lands north of the Oldman river from a point north of Macleod to the mouth of the Little Bow river has been a live issue since 1910. Many schemes have been proposed, the most feasible one of which began to take shape in 1913 as a result of the surveys carried out by this branch during that season. The surveys were continued in 1914 and 1915 and full reports of the investigations leading to the choice of route for the main canal and an approximate determination of the areas which could be irrigated from it are contained in the irrigation reports for those years. The information and arguments given in those reports need not be repeated here.

Changes in the Boundaries of the District.—Prior to 1916 the estimates of cost and area, included the lands in the neighbourhood of Carmangay, Barons and Rocky coulee. The settlers in these districts in March, 1916, held a meeting in Barons and adopted a resolution opposing the inclusion of their lands in the proposed irrigation district. Inasmuch however, as the settlers in the balance of the district were anxious to have their lands irrigated it was decided to complete the surveys and estimates of the project, excluding the parts in the west and north which were opposed to it. Fortunately the construction of the system as modified appears to be just as feasible as under the plans originally proposed.

Field Work, 1916.—On the completion of the preliminary survey of the Macleod Irrigation Project, June 1, Mr. T. M. Montague moved his party to the neighbourhood of Monarch to complete the surveys of the Lethbridge Northern Project.

Relocation of Main Canal.—The reduced area to be served and the adoption of a higher duty of water than originally estimated obviate the necessity of a storage reservoir in connection with this project. The Keho Lake reservoir, therefore, has been abandoned.

The former location for the main canal remains unchanged from the intake on the Peigan Indian reserve to the Kenex flume in section 10, township 11, range 24, west of the 4th meridian, with the exception of minor revisions made in the office. At that point the original location turned northeast and by means of a deep cutting reached Keho lake. The new location turns southeast, paralleling what was known as the South Branch canal. In section 13, township 10, range 24, the location turns northeast and runs generally in this direction until it connects with the previous locations in section 26, township 11, range 22. This location links up with the Turin branch at the point where the outlet of the Keho reservoir previously did and thus forms a section of a continuous route from the intake at the Oldman river to the extreme eastern end of the tract.

It will be noted that it is still possible to continue the main canal into Lake Keho and utilize it as a storage reservoir as formerly designed, in case future extensions of the irrigable area or other reasons demand it.

Plane Table Surveys.—The land remaining to be plane tabled in 1916 consisted of three separate parcels situated in township 10, range 24, townships 9 and 10, range 23, and township 8, range 22, west of the 4th meridian. In all there were thirty-three full sections or parts of sections having a total acreage of 16,000 acres. This work was completed on July 24.

Soil Tests.—Prior to 1916 forty-eight groups of soil samples had been taken in connection with the surveys on this project. Seven of these had been sent to Ottawa for chemical analysis and forty-one had been tested with the electrical bridge to determine the amount of alkali they contained. During 1916 Mr. V. Meek, who had taken the previous samples, took sixty additional groups at carefully selected points distributed over the project. All of these were tested with the electrical bridge, and in every case where the electrical resistance indicated moderately strong, strong, or very strong alkali, at any depth, the entire group, usually consisting of four samples extending from the surface to five feet below the surface, was sent to Ottawa for chemical analysis.

This work has been done under the general directions of Dr. Frank T. Shutt, Dominion Chemist, who made a field inspection of the soils on the project in June, 1916.

Test Borings along Main Canal.—After the completion of the survey work on the Macleod Project, the Lethbridge Northern Project and the Taber Irrigation District, Mr. Montague was instructed to take a small party and make borings along the route of the main canal of the Lethbridge Northern Project. These borings were made at intervals of about two miles and to a depth of about two feet below the bottom grade of the canal. They were made for the purpose of showing the formation below the surface of the ground to aid in making an estimate of the cost of excavation and to determine whether any conditions adverse to canal construction were likely to be encountered. The information obtained has been plotted on the profile of the canal. No particularly adverse conditions were discovered with the exception of a gravel formation for a few miles just north of the Oldman river crossing. This may cause excessive seepage losses until it becomes silted over. It will be referred to again under the estimates of cost.

An effort was made also to secure information relative to the nature of the underlying strata at the proposed dam site on the Oldman river. Two pits were sunk with pick and shovel. One of these was sheet piled and a hand pump installed, but the capacity of the pump was insufficient to keep the water down, and it was therefore impossible to go much below the water surface in the river. A gas pipe was driven about ten feet further. The material appeared to be gravel for that depth. To obtain complete data a drilling outfit suitable for working in gravel and boulders will have to be used. For the purpose of our present estimates it was assumed that the dam will rest on a porous foundation. Further tests should be made before final plans are drawn up. If it is then found that an impervious stratum is within easy reach, the present plans can be readily modified and a saving in cost of construction effected.

This work was completed on September 13 and the party disbanded.

Office Work. Estimates of Cost.—An office staff of from three to six men under the supervision of the Assistant Chief Engineer has been engaged on this project throughout the year. The work was in direct charge of Mr. V. Meek until he enlisted for active service as Lieutenant, Divisional Engineers, with the Canadian Overseas Army, in November, 1916. Since then it has been in charge of Mr. C. M. Arnold. Previous estimates which were rather general in their nature and based on incomplete field surveys were carefully gone over. Where no changes were necessary they were checked and accepted. In nearly all cases however, new information and a more careful study made new calculations necessary. The present estimates have received very careful study and are as complete and accurate as it is possible to make them until the final location of the ditches and structures are actually staked out in the field and the details of each structure worked out. It is believed that, aside from radical changes in unit costs of labour and materials, which cannot be foreseen, the estimates herein given will agree with the final estimates within less than ten per cent, and that, on the whole, the present estimates are high rather than low. At any rate the information now at hand is as complete as there is any justification in securing, until

actual construction is definitely authorized and is ready to be undertaken. The limitations of this report make it impossible to record all the details of the information which has been compiled, hence only condensed descriptions and summaries can be given.

The Irrigable Areas.—Accurate plane table surveys of all irrigable areas on a scale of 400 feet to the inch have been made and the land carefully classified. This classification shows the total net irrigable acreage served by the proposed system to be 97,531 acres.

This is divided as to areas under main canal or main branches as follows:—

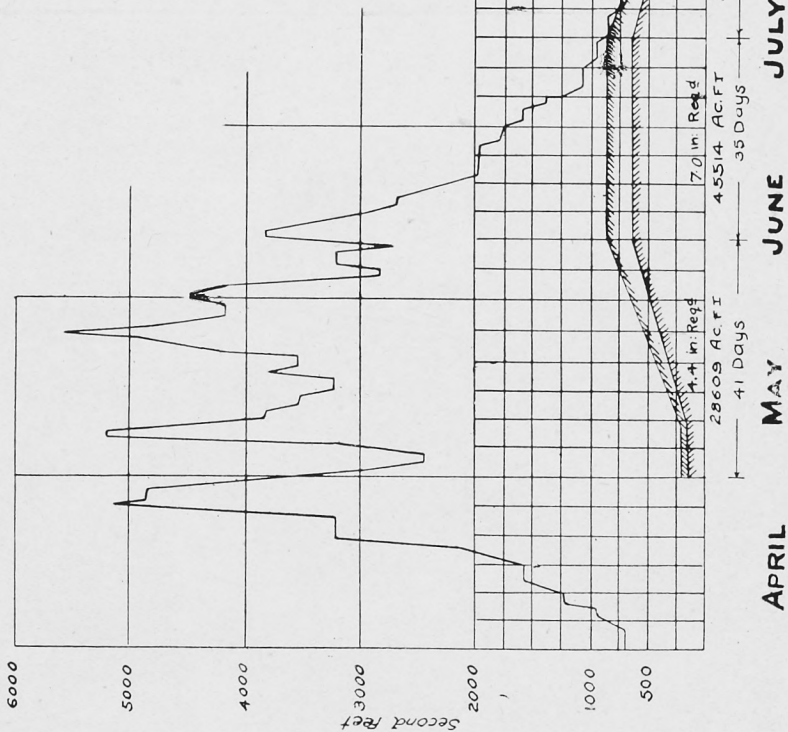
Main canal branches..	19,311	acres
South branch..	18,335	"
North branch..	18,348	"
Turin branch..	41,537	"
Total..	97,531	"

These figures have been used in determining the water requirements and in the design of the canals and structures. It should be understood however, that they are the result of an office classification only, and are subject to a correction upon a final location of distributaries and upon a field inspection of the lands themselves. The changes in areas are not likely to exceed five per cent in either direction, and are more likely to show a reduction than an increase. In other words the irrigable area may be accepted as being between 93,000 acres and 100,000 acres. It will be noted that these figures are considerably higher than the preliminary estimates for the corresponding districts published before the plane table surveys were available.

Water Supply.—The available water in the Oldman river is shown on the accompanying hydrograph for the year 1910. The year 1910 was taken because it shows the lowest discharge for the seven years during which records have been kept.

The hydrograph shows the water requirements for an irrigable area of 97,531 acres. The areas and figures show the net, and the gross amount of water required at the intake, the difference being the calculated loss in the system. No storage is considered necessary, as the small deficiency shown in the latter part of July, 1910, in a year of very low water is considered negligible. Every other year for which records are available shows a large excess throughout the entire season.

Department of the Interior IRRIGATION BRANCH **HYDROGRAPH** **OLDMAN RIVER** GAUGING STATION NW 1/4 Sec 10, T29, R2E, S14N, M. 1910



LEGEND

Ac. Ft.
Net requirement for 97431 Acres = 117037 shown thus
Total losses = 39430
Gross requirement = " = 156467 "

Seasonable Demands.—The best information available indicates that the irrigation demands in Southern Alberta and similar locations are very light at the beginning of the irrigation season in May, gradually increasing to a maximum by June 10, and continuing at a maximum until July 15, when they again decrease till about August 20, and continue very light through September. The canals are designed of such capacity however, and the supply in the river, with the exception of a short period during one year out of seven, is such, that extreme flexibility will be possible in operation to meet the seasonable requirements of any year which may depart widely from the average.

Duty of Water.—On March 20, 1916, a memorandum by S. G. Porter, Assistant Chief Engineer, defining the duty of water and the basis for calculating the capacities of canals on the Lethbridge Northern Project was approved by the Superintendent of Irrigation. The basis of the decision was:—

1. A net duty of water of 1.5 acre-feet per acre per season.
2. An irrigation factor of 80 per cent (1.5 acre-feet on 80 per cent of the irrigable area is equivalent to 1.2 acre-feet on full irrigable area).
3. That 50 per cent of the total irrigable area will require an irrigation six inches deep within a period of fifteen days.

Design of Canals.—The maximum irrigation requirement as designed above fixes the net capacity of the canals at one second-foot per one hundred and twenty acres of irrigable land, based on the entire irrigable area, the irrigation factor having already been considered.

For canals carrying less than 50 c.f.s. an additional capacity has been provided to allow for a rotation system of delivery, with a minimum irrigating head of 2.5 c.f.s.

As far as practicable the canal sections were designed according to the formula.

$$b = d^2 - d h$$

in which

b = bed width

d = depth of water

h = side slope ratio

h = $1\frac{1}{2}$ if d = 5 or less

h = 2 if d is over 5'

For canals of thirty feet bed width or larger the lower bank was made twelve feet in width, the upper eight feet in width. Free board was made half the depth of water with a maximum of three feet.

For small ditches the sections as far as practicable were made to conform to the following standard sizes:—

Bed Width.	Depth of Water.	Side Slopes.	Width of Bank.	Free- board.
	ft.		ft.	ft.
2.5.....	1.0	$1\frac{1}{2}$ to 1	3	1
3.0.....	1.0 to 1.5	$1\frac{1}{2}$ to 1	3	1
3.5.....	1.5 to 2.0	$1\frac{1}{2}$ to 1	3	1
4.0.....	2.0 to 3.0	$1\frac{1}{2}$ to 1	3	1.5
4.5.....	3.0 to 3.2	$1\frac{1}{2}$ to 1	4	1.5
5.0.....	3.2 to 3.4	$1\frac{1}{2}$ to 1	4.5	1.5

The rate of grade was made such that the velocity would not exceed three feet per second and where necessary drops were introduced to secure this.

For canals or ditches up to about eight feet bed width the value of "n" was taken at .025; larger than eight feet the value of "n" was taken at .0225.

The canals and ditches on the whole system have been designed for a bank on both sides except where the location is on a steep side hill making it unnecessary.

Farm Units.—As the land in this project is already settled, the farm unit to which individual delivery has been provided, was taken as 160 acres. Therefore each quarter-section will have a separate delivery.

Absorption Losses.—Absorption losses in canals have been allowed for at the average rate of 6 c.f.s. per million square feet of wetted area. This amounts to 25.2 per cent of the gross requirements of the system.

Spillways and Drainage.—Spillways are provided as follows:—

On the Main Canal.—1. At Willow creek flume. To discharge full capacity of canal.

2. At Rocky coulee flume. To discharge 500 c.f.s. or about one-half full capacity of canal. Estimate includes cost of constructing a channel one and a half miles long to connect with the coulee proper.

3. At Pyami coulee; end of main canal. To discharge full capacity of canal. Main canal here divides into the Turin and North branches.

On Branch Canals.—1. South branch. Seventy-two cubic feet per second through Secondary "A" and District "4A", thence into a coulee and to the river; eighteen cubic feet per second through a tail channel into a coulee to the river near the south boundary of township 9, range 22. Combined capacity ninety cubic feet per second, or one-half total capacity of South branch.

2. Turin branch. Sixty cubic feet per second through Secondary "A" into a coulee in section 35, township 10, range 21; twenty-six cubic feet per second through Secondary "B" into a coulee in section 25, township 11, range 21; sixty cubic feet per second through Secondary "E" and a tail channel into a coulee in section 28, township 11, range 19. Combined capacity 146 c.f.s., or 42% of the total capacity of the Turin branch.

3. North branch. Twenty cubic feet per second through Secondary "A" into a coulee; undetermined amount through Secondary "C" and into a coulee. A system of drainage ditches is projected for the drainage of a large tract in the east half of township 11, range 20, which is a rolling country without natural drainage.

The cross drainage along the main canal and branches has been provided for by the use of corrugated iron culverts with their intakes at ground surface and laid so that the top of the pipe will be at least two feet below the bed of the canal.

Canal and Ditch Locations and Alignment.—All canal and ditch locations are projected on topographical plane table maps, giving contours at intervals of five feet and in part intervals of one foot, or on maps of preliminary surveys giving contours at intervals of five feet; all such maps being on a scale of 400 feet to the inch except the first three miles of the main canal which is on a scale of 200 feet to an inch.

For the canals having a capacity of over 40 c.f.s., these lines are projected on the maps and topographical sheets showing accurate curve and tangent alignment, but the location lines are not run in the field. For smaller ditches the alignment is merely sketched.

The projected location of all canals and distributaries is shown on the general plan accompanying this report.

Profiles are all plotted from the projections on contour maps.

It is expected that when canals are finally located in the field a better balance of cut and fill can be obtained, which will tend to decrease the estimated earthwork cost.

During 1916 the location of the main canal line was entirely revised from station 233 to station 2041, with the object of,

1. Providing sufficient fall or head at the north side of the crossing of the Oldman river to make it possible to use a wood stave pipe for this crossing at a cost which would not exceed that of a flume.

2. To cut out a five foot drop at about station 1890 called for by former projection.

In making the revisions referred to, savings were effected at some points and added costs were encountered at others; the final result being slightly in favour of the revised line.

Structures—Standard Types.—All structures on ditches having a capacity less than 40 c.f.s. are to be timber; on canals having a capacity greater than 40 c.f.s. to be concrete, with the exception of highway bridges and large flumes which are to be of timber.

For moderate sized flumes say up to six or seven feet diameter it is proposed to use steel flumes on timber trestles.

Standard designs for turnout gates, drops, bridges, flumes and weirs were adopted with tables or diagrams for reading off the quantities and costs for the varying sizes and other governing conditions.

SPECIAL STRUCTURES—MAIN DIVERSION WORKS, OLDMAN RIVER.

Main Features.—The proposed main diversion works consist of a gravity type concrete weir 600 feet long, built on a concrete floor of varying thickness 58 feet in width, 27.5 feet of which is down stream from the weir toe and 30.5 feet up stream; a main gate structure on the south bank, and a sluiceway covering the south 50 feet of the river bed and adjoining the gate. The crest of the weir is 7.5 feet above the stream bed.

Sluiceway.—The sluiceway consists of six gate openings each six feet wide. Its installation is proposed for the purpose of sluicing through any sand or gravel which would otherwise lodge against the intake gates or be drawn into the canal through them and have to be removed by expensive methods.

Gate Structure.—The intake or gate structure joins the sluiceway at its easterly end, the face of the gate being at right angles to the weir and sluiceway and coinciding with the river bank.

It consists of seven openings each six feet wide by 4.75 feet deep with six piers each two and one-half feet thick at the gates, making a total width of opening of 57 feet.

The piers are made a width of 16 feet on top, supporting a floor slab which provides a roadway for the use of the operating staff in addition to the space required for the gate lifting devices.

The piers and the floor on which they rest are designed for the most unfavourable condition which may arise, which is when the river is in extreme flood and the gates closed with no water below them.

The crest of the weir is at elevation 3,211; grade of canal 3,202; in canal 3,210; floor of weir 3,203.5; top of gate sill 3,204.25.

Height of gate opening 4.75 feet.

Discharge through gate openings:—

$$4.75 \times 6 \times 7 \times 5.5 = 1,097 \text{ c.f.s.}$$

Character of Foundation.—From information obtained from tests dug near the site it is believed that the material in the bed of the river is boulders and gravel to an indefinite depth, and accordingly the design of the weir and gates has been made for a pervious foundation.

The foundation floor has been designed in accordance with Bligh's formula, using a percolation factor of nine.

at 5 per cent at the end of eight years would become \$46,490. The estimated cost of installing the second 9-foot pipe at that time is \$39,457.

It is proposed to cross the main river channel on a steel bridge consisting of three 120-foot spans supported by concrete piers.

ESTIMATED COST OF THE PROJECT.

A tabulated statement is given herewith, summarizing the cost of the system. It will be noted that the cost of the main canal and main branches, constituting the trunk system, has been kept separate from the cost of the distributing system, and is called the "overhead cost." This enables one to analyse the cost to any particular district.

Unit Prices.—It is a difficult matter, even in times of most stable economic conditions, to forecast the unit prices of labour and material which will prevail at some undetermined time in the future when the construction of a project may be undertaken. The uncertainties of after-war condition immensely increase these difficulties. The unit prices used in this report will apply to reasonably normal conditions, but if construction should be undertaken under decidedly abnormal economic conditions they will, of course, need to be modified accordingly.

Earthwork.—An average cost of twenty cents per cubic yard has been allowed for excavation on all the work except the first three and one-half miles of the main canal where an average cost of thirty cents was assumed.

Timber in Place—

Average price fir timber per M Ft. B.M.	\$25 00
Haul.	6 00
Iron, 160 pounds per M. Ft. B.M. at 3½ cents.	5 60
Excavation, trenching and refilling.	2 15
Framing and erection of timber.	11 25
Total cost per M. Ft. B.M. in place.	\$50 00

LETHBRIDGE NORTHERN IRRIGATION PROJECT.

SUMMARY OF ESTIMATES.

Description.	Dimensions.	Quantities.	Unit Costs.	Cost.	Remarks.
Excavation.....		5,624.550 cu. yds.....	20c. per cu. yd.....	\$ 1,124,910	
".....		362,651	30c.	108,795	
Concrete Gates and Holdup Gates.....				98,600	
Siphons—Wood.....	3,375' long.....	1.12' diam. Wood Stave.....		10,092	
"—Concrete.....		3		85,391	
Flumes—Wood.....		3 { 2,539,200 F.B.M.....	\$50 per M. F.B.M.....	3,475	
"—Steel.....		7 { 37,196 lin. ft. Piles.....	50c. per lin. ft.....	145,558	
Bridge at Oldman Riv. Crossing.....	120' steel spans.....	3		14,454	
Railway Bridge Crossings.....	40' Plate Girder.....	3		58,825	
Road Bridges.....		2		12,000	
Farm Bridges.....		523		118,847	
Concrete Drops.....		287		15,617	
Timber Drops.....		76		50,401	
Timber Headgates.....		675		27,919	
Turnouts—Concrete.....		1,630		25,093	
"—Timber.....		152		12,777	
Weirs.....		15		420	
Corrugated Pipe Culverts.....		1,073		7,908	
Fencing.....		56		14,598	
Telephone Line.....		81.2 Miles.....	\$300 per mile.....	24,360	
Right of Way.....		65.0 "	\$200 "	13,000	
		2,363 Acres.....	\$40 per acre.....	94,520	
				2,067,560	
				2,206,756	10% Engineering and Contingencies.
				2,274,316	÷ 97,531 Ac. = \$23.32 per acre (Irrigated).

LETHBRIDGE NORTHERN IRRIGATION PROJECT.—ESTIMATE OF COST.
TURIN AND NORTH BRANCH DISTRIBUTARIES.

Canal.	Sta.	Irrig- able area Acres.	EXCAVATION.		STRUCTURES.												Cost per acre.	Over- cost per acre.	Total cost per acre.			
			Cu. Yds	Est'd. Cost.	Chutes and Drops.		Headgates.		Turnouts.		Weirs.		Flumes.		Bridges.					Culverts.		Cost.
					No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.				No.	Cost.	
Turin Br., Sec. E.....		8,830	160,985	\$ 32,197	40	\$ 4,182	109	\$ 1,721	16	\$ 1,049	79	\$ 610			52	\$ 3,359	3	\$ 450	\$ 43,568	5-43	18-99	24-42
" " D.....		5,380	76,545	15,309	27	1,170	83	1,258	8	243	58	428			37	2,009	2	300	20,717	4-23	18-99	23-22
" " C.....		2,755	47,350	9,470	7	280	68	1,161	1	28	41	298	2	4,990	30	1,646	2	300	18,173	7-25	18-99	26-24
" Branches 297 to 648...		5,383	47,037	9,407	2	52	69	1,064			49	365			34	2,627			13,515	2-76	18-99	21-75
" " Sec. A.....		10,019	156,976	31,395	50	5,568	144	2,453	21	1,250	98	726			62	3,511	5	750	45,653	5-01	18-99	24-00
" " B.....		3,314	54,495	10,899	23	908	73	1,245			41	301			25	1,450	3	300	15,103	5-01	18-99	24-00
" Branches from 0 to 297.....		5,856	49,345	9,869	34	1,012	84	1,011			52	390			50	3,090			15,372	2-88	18-99	21-87
North Branch.....	820 to 1065 and Distrib	18,348	185,848	37,170	245	7,438	325	4,983			212	1,540			121	8,072			59,203	3-55	18-99	22-54
Drainage Ditch.....	T. 11, Rg 20	2,337	64,327	12,865	6	272									9	800			13,937			
		842,908	168,581	434	20,882	955	14,896	46	2,570	630	4,658	2	4,990	420	26,564	15	2,100	245,241				

MAIN CANAL AND SOUTH BRANCH DISTRIBUTARIES.

Canal.	Sta.	EXCAVATION.			STRUCTURES.														Cost per acre.	Over-head per acre.	Total cost per acre.	
		Irrig-able Area Acres.	Cu. Yds	Est'd. Cost.	Chutes and Drops.		Headgates.		Turnouts.		Weirs.		Flumes.		Bridges.		Siphons.					Cost.
					No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.	No.	Cost.						
Main Canal Brs.	3119 to 3486	5,100	48,460	9,692	84	\$ 2,785	86	\$ 1,252			57	\$ 415			23	1,019			\$ 15,163	2-97	18-99	21-96
South Branch.....	{ 0 to 1124 552 to 1124	18,335	257,426	51,485	119	9,269	336	5,075	16	1,006	220	1,618	2	3,884	148	8,812	1	1,050	82,199	4-48	18-99	23-47
Main Canal Brs.	2398 to 3119	14,211	136,707	27,341	68	4,629	253	3,870	7	434	166	1,217			82	3,889			41,380	2-91	18-99	12-90
		442,593	88,518	271	16,683	975	10,197	23	1,440	442	3,250	2	3,884	253	13,720	1	1,050	138,742				

Pile driving per Lineal foot—	Cents.
Cost of pile.. . . .	15
Haul.. . . .	1
Trimming and peeling.. . . .	2
Driving.. . . .	25
Sundries.. . . .	7
Total cost per lineal foot in place	50

Reinforced Concrete.—For general construction on canals and ditches assume an average haul of ten miles for all materials.

	Cost per cubic yard Concrete.
Cement—1½ barrels at \$2.90.. . . .	\$ 3 63
Haul.. . . .	1 00
Steel—60 pounds at 3 cents.. . . .	1 80
Haul.. . . .	12
Placing at 1 cent per pound.. . . .	60
Forms, in place 80 square feet at 9 cents.. . . .	7 20
Sand and gravel.. . . .	4 20
Mixing and placing.. . . .	2 75
Excavation, trenching, backfill, etc.. . . .	3 00
Sundries, say.. . . .	2 70
	<hr/> \$27 00

For points on the Oldman river assume an average haul of four miles for cement, steel and lumber and one-half mile for sand and gravel and a total cost of \$21 per cubic yard.

Plain Concrete.—Use \$9 per cubic yard for points on the Oldman river and \$16 for remainder of system.

Fencing.—It is proposed to erect a fence on both sides of right of way on all canals having a bed width of 10 feet and over. Estimated at \$300 per mile of canal.

Telephone Line.—Provision for telephone line covering the length of the main canal has been made at an estimated cost of \$200 per mile.

Right of Way.—A unit price of \$40 per acre was allowed for right of way for all constructed channels of all sizes. That price is intended to cover incidental damages as well as actual value of land taken. No cost of right of way has been included for natural channels where they are utilized for canals or spillways. There may, however, be damages in some cases by overflow or inconvenience caused by such use.

Total Cost of the System.—The total cost of the system as shown in the tabulated estimates, after adding 10 per cent for engineering and contingencies, amounts to \$2,274,316.

This amount distributed over 97,531 acres of irrigable land gives an estimated cost of \$23.32 per irrigable acre.

SOME POSSIBILITIES NOT INCLUDED IN THE ESTIMATES.

Lining Canals.—It has been noted that for a distance of two or three miles just north of the Oldman River crossing, the main canal will be constructed through a gravelly formation. The seepage losses from that section are likely to be high, for a few years at least. It is thought, however, that after five or six years it will have become silted over to such an extent that the losses will not be serious. During that period the full capacity of the canal is not likely to be required and the extra loss will not be felt. Likewise the location is near the river and it is most probable that the gravel stratum will conduct the seepage back to the river without causing any surface damage to adjacent lands. If these assumptions prove to be incorrect some

steps may have to be taken towards lining or artificially silting the worst portions. No provisions have been made in the estimates for this item, for if it has to be done at all it will be after several years of operation, and can be undertaken as a maintenance charge. Neither was any additional seepage loss allowed for, it being considered that an average loss of six c.f.s. per million square feet of wetted area over the entire system was ample.

Protection of Natural Channels.—Several natural channels are to be used as spillways. Since the flow through them will be at infrequent intervals and of brief duration, it is not thought that any damage will result, and hence no allowance has been made for their protection. Pyami coulee, in addition to being used as a spillway, is utilized for a distance of about three miles as the carrying channel for the Turin branch canal. It is possible that after a number of years of operation some protection will be needed. Under the circumstances it is considered more economical to wait until the necessity arises and then if it does arise the required work can easily be done as a maintenance charge.

Future Extensions.—There is one other point that should be mentioned in connection with this report, and that is the possibility of further extensions of the system and their bearing on the cost and operation of the Lethbridge Northern Project. Two reservoirs have been mentioned, the Castle river reservoir, and lake Keho reservoir, either or both of which may be developed and utilized in conjunction with this system or its extension. There are likewise two directions in which the system may be extended, either of which would require storage. (1) to include the areas in the Carmangay, Barons and Rocky coulee districts, should future conditions induce the settlers there to petition to be re-admitted. (2) An extension across the Little Bow river to the Sundial district and other areas between the Bow and Little Bow rivers lying west of the Southern Alberta Land Company's tract. Settlers in these districts have already petitioned for irrigation water, and preliminary investigations indicate that a considerable area could be irrigated either by extending the Lethbridge Northern Project or by enlarging the Southern Alberta Land Company's canal. A thorough investigation would be required to determine which would be the more feasible.

THE MILK AND ST. MARY RIVERS IRRIGATION PROJECT.

Previous surveys and Reports.—The earliest investigations of this project were carried out by Mr. George G. Anderson, Consulting Engineer, of Denver, Colorado, and several reports submitted by him were published in connection with the International Waterways treaty between the United States and Canada.

During the year 1914 preliminary surveys were carried out by this branch primarily for the information of the International Joint Commission. Reports showing the methods of carrying on the field work, together with some approximate estimates of available water supply and cost data were published for that year.

During the year 1915 this branch again placed parties in the field to make more detailed surveys, particularly of those tracts of land which, from the previous year's surveys, it was determined could be the most economically served.

Office Work, 1916.—During 1916 the office work, based on the field surveys already made, was continued by Mr. B. Russell, Chief Field Inspector, under the direction of the Assistant Chief Engineer. He has projected in as much detail as the information available would permit, a complete system of canals to serve the various tracts described, and has compiled estimates of the cost of their construction. The discussion and estimates herewith given are abstracted largely from his report to the Commissioner of Irrigation.

Nature and extent of Field Surveys.—Since the estimates embodied in this report have been based on the surveys made in 1914 and 1915, a word should be said here regarding the nature and extent of those surveys.

Upon commencing the work in 1914 there was practically no information available regarding the general elevations of the country under the proposed system of canals now known as the Milk and St. Mary Rivers Irrigation Project, so for that year the work attempted was of a very preliminary nature, consisting mainly of running a system of levels over the township lines in an endeavour to isolate those tracts of land which could be irrigated by a system of canals from the various sources under consideration.

During the year 1915 it was attempted to run out in a preliminary way most of the main canal routes, and to determine by a closer system of levels the irrigable areas in those tracts previously isolated.

In carrying on this system of levels the instrument men were instructed to take as many and as detailed notes as possible regarding the nature of the land levelled over, and to estimate roughly the percentage of irrigable land in each section or township covered, irrespective of whether it could be commanded or not.

From these surveys all of the estimates included in this report have been compiled, and it should be remembered, particularly with regard to the estimates of irrigable areas, that although most of the sections were actually looked over and the percentage of irrigable land roughly estimated by an instrument man, these men were generally inexperienced in this respect, and further, had no means of knowing, in a great many cases, what portions could actually be commanded by canals. In compiling the estimates a considerable difference of opinion was noted in some cases where two men separately estimated the percentage of the same piece of land. It was, therefore, very difficult to determine in many cases just what a fair percentage would be.

General Features.—The general features governing the design of this project, together with a fairly complete discussion of the available water supply, will be found in the annual report for the year 1914, so that it will not be necessary here to repeat what has already been fully dealt with. It is proposed simply to make this report more or less of an enlargement of the one referred to, and it will be more readily followed by referring to that report.

It may be well, however, to point out some of the features which tend to complicate this project and make it very difficult to estimate in dollars and cents.

1. The sources of water supply and the reservoir sites required are very widely distributed, making the study of transportation a very complicated and difficult one.

2. It has not as yet been definitely decided what proportion of the discharge of the St. Mary river water Canada will be entitled to receive.

3. The various tracts of irrigable land are widely distributed, separated by wide and deep coulees, and located at very great distances from the sources of supply.

4. The whole project is closely bound up with the Alberta Railway and Irrigation Company's canal system, making the estimates of cost very complicated and difficult.

In compiling the estimates embodied in this report it has been assumed that Canada's share of the flow of the St. Mary river at the international boundary line will be fifty-five per cent of the discharge of this stream at that point, and that her share of the flow of Milk river will be all of the discharge of that stream measured at the gauging station at Milk River station.

In order to utilize all of the St. Mary river water it will be necessary, by means of reservoirs, to store the winter flow and the high peaks of floods. In these estimates it has been assumed that this will be accomplished through co-operation with the United States by the use of the St. Mary lakes.

In regard to the Alberta Railway and Irrigation Company's system of canals, a fuller discussion will be found farther along. The estimates shown in this report are based on the assumption that any further development of irrigation in the country under consideration will be along the lines of extending and enlarging the system of

canals already in operation. The two projects are so closely allied that this is necessary. In making the estimates it was, therefore, necessary to determine the cost of enlarging practically the whole length of their main canal, renewing all of the larger structures as well as building many new structures throughout their system. The information available upon which to base an estimate of cost of this enlargement is very meagre, making the estimates of the whole project uncertain.

Irrigable Areas.—A full description of the irrigable tracts has been made in previous reports, together with a rough estimate of the irrigable areas in the various tracts outlined.

In estimating the irrigable areas in more detail, the same notation of tracts has been adhered to, with the exception of tracts 5-A and 5-B. It was found upon further study of the conditions that some 15,000 acres previously included in tract 5-A could be more economically irrigated from the main canal to tract 5-B, and is here included in this tract.

The following table shows the irrigable areas estimated in the various tracts considered:—

Tract.	Irrigable Acres.
5-A.	78,000
5-B.	100,000
6	28,300
7-A.	49,100
7-B.	29,000
7-C.	29,500
	<hr/>
	313,900
	<hr/>

There was no information available from which to revise the estimates previously made of the irrigable acres in tracts 1, 2, 3, 4 and 8. It is believed, however, that the estimates previously submitted for these tracts are approximately correct. They are as follows:—

Tract.	Irrigable Acres.
1-A.	20,400
1-B.	4,100
2.	31,700
3.	104,450
4.	6,800
8.	20,000
	<hr/>
	187,450
	<hr/>

This gives a total estimated irrigable area in the entire project of 501,350 acres.

In comparing the above estimates with those submitted in 1914, a considerable difference will be noted, particularly with regard to the estimates of tracts 5-A and 6.

It was found in actually running out the secondary canals through tract 5-A that a large area of good land in the vicinity of Grassy lake was too high to reach, owing to a wide draw stretching up in a westerly direction from the head of Forty Mile coulee. Although the main canals are above the most of this country, a very long syphon would be required to reach it. The estimates of cost have been made upon the assumption that it will not be feasible to reach this area, but with more detailed surveys it may be found feasible to reach at least some of this land.

It was roughly estimated in 1914 that 84,000 acres of tract 6 would be irrigable, but it was realized that the cost per acre for this would be very great.

In the estimate of cost to irrigate this tract included in this report, it has been deemed advisable to cross Etzikom coulee at an elevation sufficiently high to command only 28,300 acres of the best land in the tract. It is possible to deliver water to the tract at a much higher elevation but the land is so broken and rough that it is considered out of the question to irrigate it.

Judging from the estimates of irrigable area completed in connection with the Lethbridge Northern Irrigation Project it would seem that the estimates submitted here are from ten to fifteen per cent low. These estimates were purposely made conservative and there is no doubt but that a plane table survey of these tracts would considerably swell the irrigable areas estimated here.

Water Supply.—The study of the available water supply made here is practically along the same lines as those adopted in the report for the year 1914. The quantity of water available cannot be determined accurately for the reasons enumerated in that report.

The same hydrographs showing the discharge of the various rivers under consideration have been used in the study made here, except that the method of drawing on the rivers has been varied to better suit the demands.

Duty of Water.—A net duty of eighteen inches of water per acre has been adopted in estimating the required amount of water, and the capacity of canals and reservoirs.

The irrigation factor taken is eighty per cent, or it is considered that only eighty per cent of the irrigable area will be irrigated in any one year.

The manner in which it is proposed to distribute the water is as follows:—

32 days from May 1 to June 2,—2 inches.
60 “ “ June 2 to August 1,—12 inches.
31 “ “ August 1 to September 1,—2 inches.
30 “ “ September 1 to October 1,—2 inches.

In the design of canals a maximum capacity has been provided to allow for a rotation in the following manner:—

To serve	80 acres or less	3 c.f.s.
“ “	320 “ “ “	4 “
“ “	640 “ “ “	8 “
“ “	1,200 “ “ “	12 “
“ “	1,200 and over	1 c.f.s. per 100 acres plus losses.
“ “	6,000 “ “	1 “ “ 120 “ “ “

Absorption Losses.—In designing for the maximum capacity of canals required an absorption loss of 6 c.f.s. per million square foot of wetted area has been assumed. The accumulation of these losses from the land back to the intake will vary somewhat with the combination of irrigable tracts used. The maximum was found to amount to 28.2% of the gross capacity.

From the standpoint of water supply it does not necessarily follow that 28.2 per cent of the total quantity of water diverted during the season will be lost. The total losses may be more or they may be less. This is an important consideration inasmuch as the amount of land which can be irrigated with the water which is available depends upon the value of these losses. The loss of 28.2 per cent is based on the condition that every canal on the system is running full capacity. In practice this is never the case. The effect of rotation is to cut out part of the distributaries entirely and thus decrease the percentage of loss. On the other hand, when the canals are not running full, the ratio of wetted area to discharge is increased and the percentage of loss likewise increased. On parts of the system the losses from some of the canals and the run-off from irrigation will be partially recovered by other canals or reservoirs at a lower elevation. Some of the reservoirs also receive the rainfall run-off from a considerable area, balancing, to some extent, the evaporation losses from their surface. Taking these various points into consideration a loss of 30 per cent, including both canals and reservoirs, has been used in making the estimates of the total water supply required.

It will be noted that in discussing the available water supply in 1914, 40 per cent was used for these losses. There was no way of determining them at that time and it was thought advisable to use a high value.

Hydrographs, Tables, Diagrams and Plans.—A great mass of detail information has been compiled and filed for record. This consists of:—

1. Hydrographs of St. Mary, Milk, Belly and Waterton rivers for the years 1911 and 1912, showing the discharges of the streams and diversions from them to meet the requirements of each extension or combination.

2. Sketches showing diagrammatically just what each extension or combination embraces.

3. A set of tables showing in detail, by months, the water supply available and how it must be stored or distributed to meet the requirements of each extension or combination.

4. A set of tables giving in detail the costs of canals, distributaries, reservoirs, dams and other structures.

5. A set of tables giving a summary of cost for each extension or combination.

6. Plans and profiles of the principal canals and distributary systems.

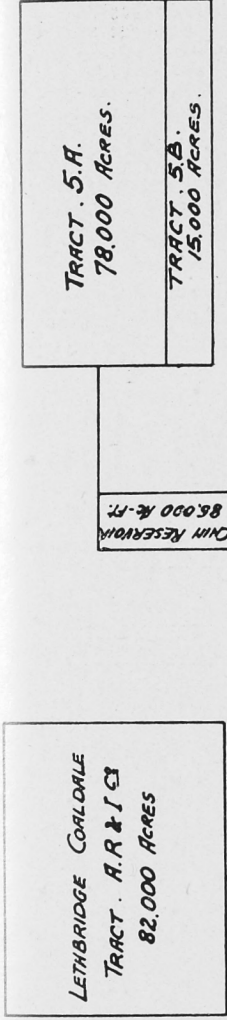
The limitations of this report make it necessary to omit all these except (2) and a general plan under (6), which are considered essential to a clear understanding of the purposes of the work. The balance of the information will be very briefly summarized.

Many Combinations Studied.—The existence of the Alberta Railway and Irrigation Company's system and its relation to any other proposed system must be recognized. The Milk and St. Mary rivers irrigation project is necessarily an enlargement of that system and has been dealt with as such. The various combinations are referred to as extensions of it.

A brief description and summary of cost of each extension and a diagram illustrating it are given herewith.

Extension No. 1.—The first extension contemplates the construction of a small canal from the Chin coulee reservoir as now constructed to irrigate 17,000 acres in tract 5-A. This is known as the Taber Irrigation District. A contract is contemplated between the Canadian Pacific Railway Company and the trustees of the district, whereby the company agrees to build the system for the district at a cost of \$11.50 per irrigable acre.

Extension No. 2 (see sketch).—Under the second extension it is proposed, after providing for the 110,000 acres of land which it is estimated will eventually be irrigated by the Alberta Railway and Irrigation Company, to enlarge and extend canals to take in 78,000 acres estimated in tract 5-A and 15,000 acres in tract 5-B. This necessitates enlarging the main canal of the Alberta Railway and Irrigation Company to a gross capacity of 1,450 cubic feet per second, and renewing most of the present structures throughout, as well as providing new structures to control the flow throughout the natural watercourses of that system. It is also necessary, for this extension, to enlarge Chin coulee reservoir to a capacity of 85,000 acre feet.



Department of the Interior

IRRIGATION BRANCH

MILK AND ST. MARY RIVERS IRRIGATION PROJECT

SHOWING

SECOND PROPOSED EXTENSION



The water supply can be secured entirely from the St. Mary river.

The estimated cost is as follows:—

Enlargement of A. R. and I. canal.. . . .	\$1,085,600 00
Chin reservoir.. . . .	118,333 00
Branch canals.. . . .	841,402 40
Distributaries.. . . .	226,743 10
Horsefly lake drainage.. . . .	73,165 00
Telephone line.. . . .	15,000 00
	<hr/>
	\$2,360,243 50
Engineering and contingencies, 10 per cent.. . . .	236,024 35
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	\$2,596,267 85

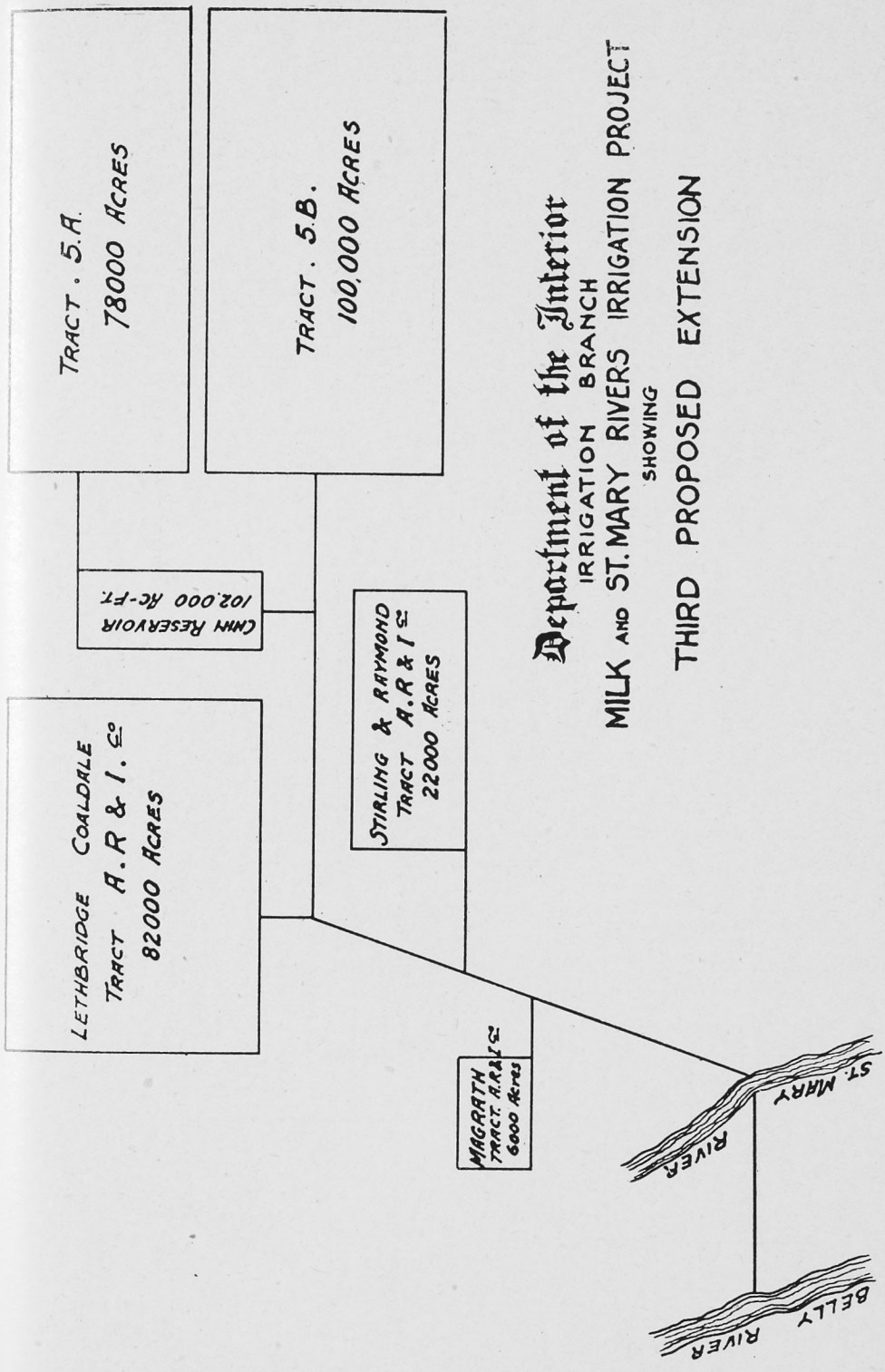
Irrigable area, 93,000 acres at \$27.90 per acre.

Extension No. 3 (see sketch).—In the third proposed extension both tracts 5-A of 78,000 acres and 5-B of 100,000 acres, in addition to the 110,000 acres of Alberta Railway and Irrigation Company lands, are provided for. In this case a canal of maximum gross capacity of 2,440 cubic feet per second is required from the St. Mary river, and a canal of 750 cubic feet per second from the Belly river. All of the present structures throughout the main canal are renewed and drops and chutes are provided to carry the water down the natural channels of the system. In this case the Chin coulee reservoir is enlarged to a capacity of 102,000 acre-feet.

The estimated cost is as follows:—

Belly river diversion canal.. . . .	\$ 654,620 00
Enlargement of A. R. and I. canal.. . . .	1,485,976 00
Chin reservoir.. . . .	171,733 00
Branch canals.. . . .	1,673,696 90
Distributaries.. . . .	558,943 75
Horsefly lake drainage.. . . .	73,165 00
Telephone line.. . . .	30,200 00
	<hr/>
	\$4,648,334 65
Engineering and contingencies, 10 per cent.. . . .	464,833 45
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	\$5,113,168 10

Irrigable area, 178,000 acres at \$28.75 per acre.



FOURTH PROPOSED EXTENSION



Extension No. 4 (see sketch).—The fourth extension anticipates, in addition to the above, extending canals, and creating the necessary storage to irrigate tract 7-A of 49,100 acres, and 17,400 acres of tract 7-B.

For this extension, in addition to the 102,000 acre-feet estimated in Chin reservoir, the following storage is required:—

Belly river lakes.. . . .	15,500 acre-feet.
Milk river reservoir.. . . .	79,000 "
Raymond reservoir.. . . .	17,000 "
Verdigris reservoir.. . . .	9,000 "

As shown on the diagrammatic sketch, a small quantity of water is required from the Milk river in addition to the other sources, and a canal from Milk river is provided for in the estimates. It should be noted that the Verdigris reservoir can be filled either from Milk river or St. Mary river.

The estimated cost is as follows:—

Cost of extension No. 3 as above.. . . .	\$1,648,334 65
Plus—	
Branch canals for Tract 7-A.. . . .	429,045 50
Distributaries for Tract 7-A.. . . .	191,210 20
East Verdigris branch for Tract 7-B.. . . .	69,811 00
East Verdigris distributaries for Tract 7-B.. . . .	60,841 65
Belly river lakes reservoir.. . . .	15,500 00
Milk river reservoir.. . . .	310,360 00
Raymond reservoir.. . . .	184,303 25
Verdigris reservoir.. . . .	41,020 00
Milk river reservoir feeder canal.. . . .	372,995 00
Verdigris reservoir feeder canal.. . . .	43,190 00
Drainage on Tract 7-B.. . . .	17,400 00
Telephone.. . . .	21,400 00
	<hr/>
	\$6,405,411 25
Engineering and contingencies, 10 per cent.. . . .	640,541 10
	<hr/>
	\$7,045,952 35

Irrigable area, 244,500 acres at \$28.80 per acre.

Extension No. 5 (see sketch).—In the fifth extension, the whole of tract 7-B of 29,000 acres is provided for in addition to the other tracts. This requires more storage in Verdigris lake, and this site has been estimated for a capacity of 21,000 acre-feet.

The estimated cost is the same as No. 4, except that the East Verdigris branch canals and distributaries for tract 7-B are increased by \$224,138.75 and Verdigris reservoir by \$5,449.30, giving a total increase of \$229,588.05.

The total estimated cost is therefore.. . . .	\$6,634,999 30
Engineering and contingencies, 10 per cent.. . . .	663,499 90
	<hr/>
	\$7,298,499 20

Irrigable area, 256,100 acres at \$28.45 per acre.

Department of the Interior

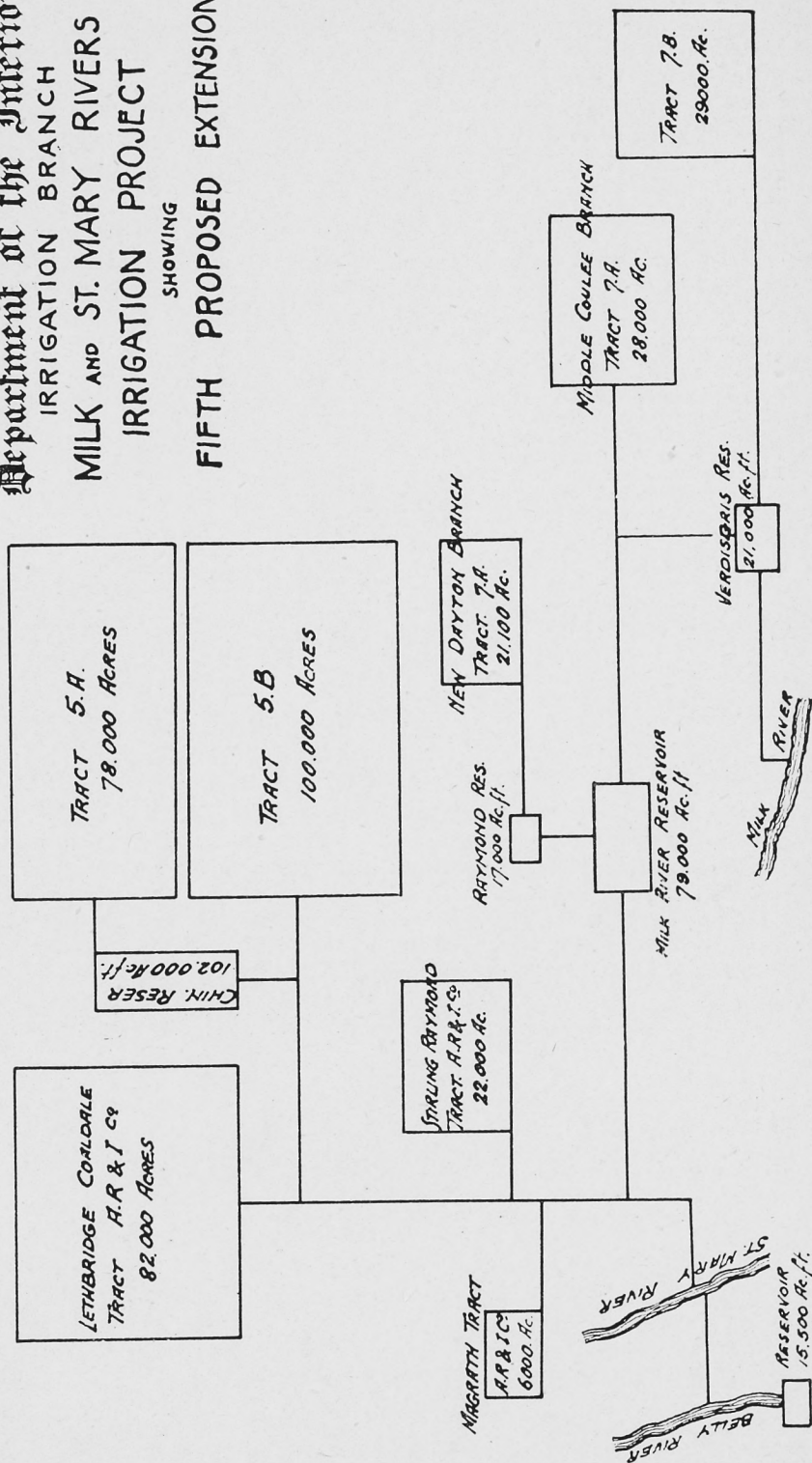
IRRIGATION BRANCH

MILK AND ST. MARY RIVERS

IRRIGATION PROJECT

SHOWING

FIFTH PROPOSED EXTENSION



Department of the Interior

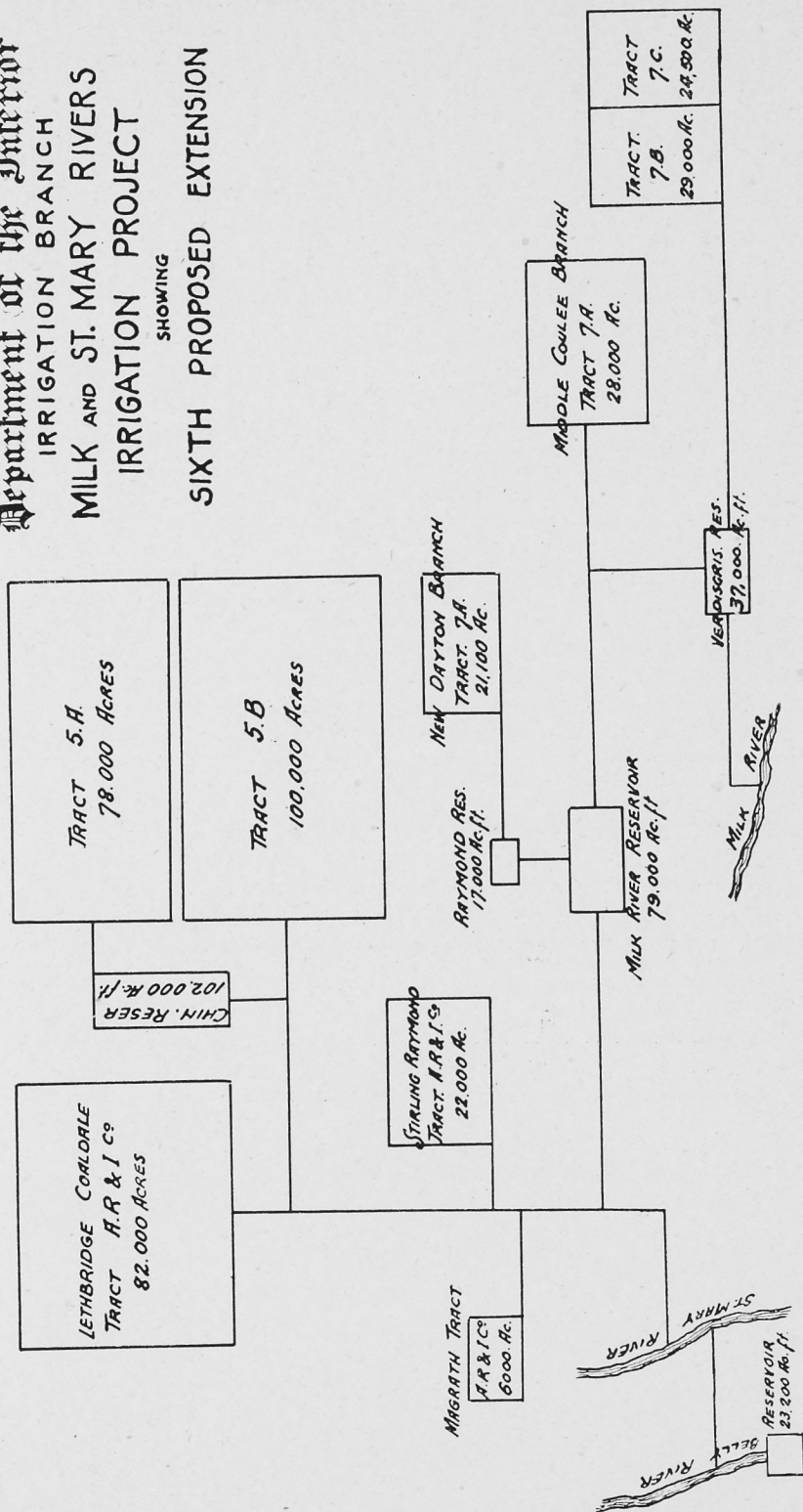
IRRIGATION BRANCH

MILK AND ST. MARY RIVERS

IRRIGATION PROJECT

SHOWING

SIXTH PROPOSED EXTENSION



Extension No. 6 (see sketch).—In the sixth extension an additional area of 24,500 acres of tract 7-C is provided for. In this extension a capacity of 37,000 acre-feet has been provided at Verdigris lake, and an additional capacity of 7,700 acre-feet on the Belly river, at Wests' ranch.

The cost is the same as No. 4, with the following additions:—

East Verdigris branch canals and distributaries for Tracts 7-B and 7-C, increased by.. . . .	\$ 812,409 25
Drainage, increased by.. . . .	68,860 00
Verdigris reservoir, increased by.. . . .	25,042 00
Belly river diversion canal, increased by (including additional reservoir).. . . .	259,968 00
Telephone line, increased by.. . . .	8,400 00
	<hr/>
No. 4 estimate.. . . .	\$1,174,679 25
	6,405,411 25
	<hr/>
Engineering and contingencies, 10 per cent.. . . .	\$7,580,090 50
	758,009 05
	<hr/>
	\$8,338,099 55

Irrigable area, 280,600 acres at \$29.65 per acre.

Extension No. 7 (see sketch).—The seventh extension anticipates irrigating, in addition to the above, 28,300 acres in tract 6. After providing for the other tracts it is necessary, in order to irrigate tract 6, to carry water from the Waterton river, and a canal of 400 cubic feet per second capacity has been estimated from that source.

In all previously discussed extensions where water was required from the Belly river, the estimates provide for carrying it over via the Mountain view and Boundary creek route, located in 1912. In order to carry water from the Waterton river, however, it is necessary to follow the more expensive route via the Blood Indian reserve and Kimball.

The estimated cost of Extension No. 7 is the same as No. 6, with the following additions:—

Main branch canal and distributaries for Tract 6.. . . .	\$ 617,045 00
East Verdigris branch, increased by.. . . .	31,000 00
Verdigris reservoir, increased by.. . . .	13,658 00
Belly river diversion canal, increased by.. . . .	316,157 00
Waterton river diversion canal.. . . .	329,760 00
Telephone line, increased by.. . . .	4,460 00
	<hr/>
Estimate No. 6.. . . .	\$1,311,420 00
	7,580,090 50
	<hr/>
Engineering and contingencies, 10 per cent.. . . .	\$8,891,510 50
	889,151 05
	<hr/>
	\$9,780,661 55

Irrigable area, 313,900 acres at \$31.15 per acre.

Department of the Interior

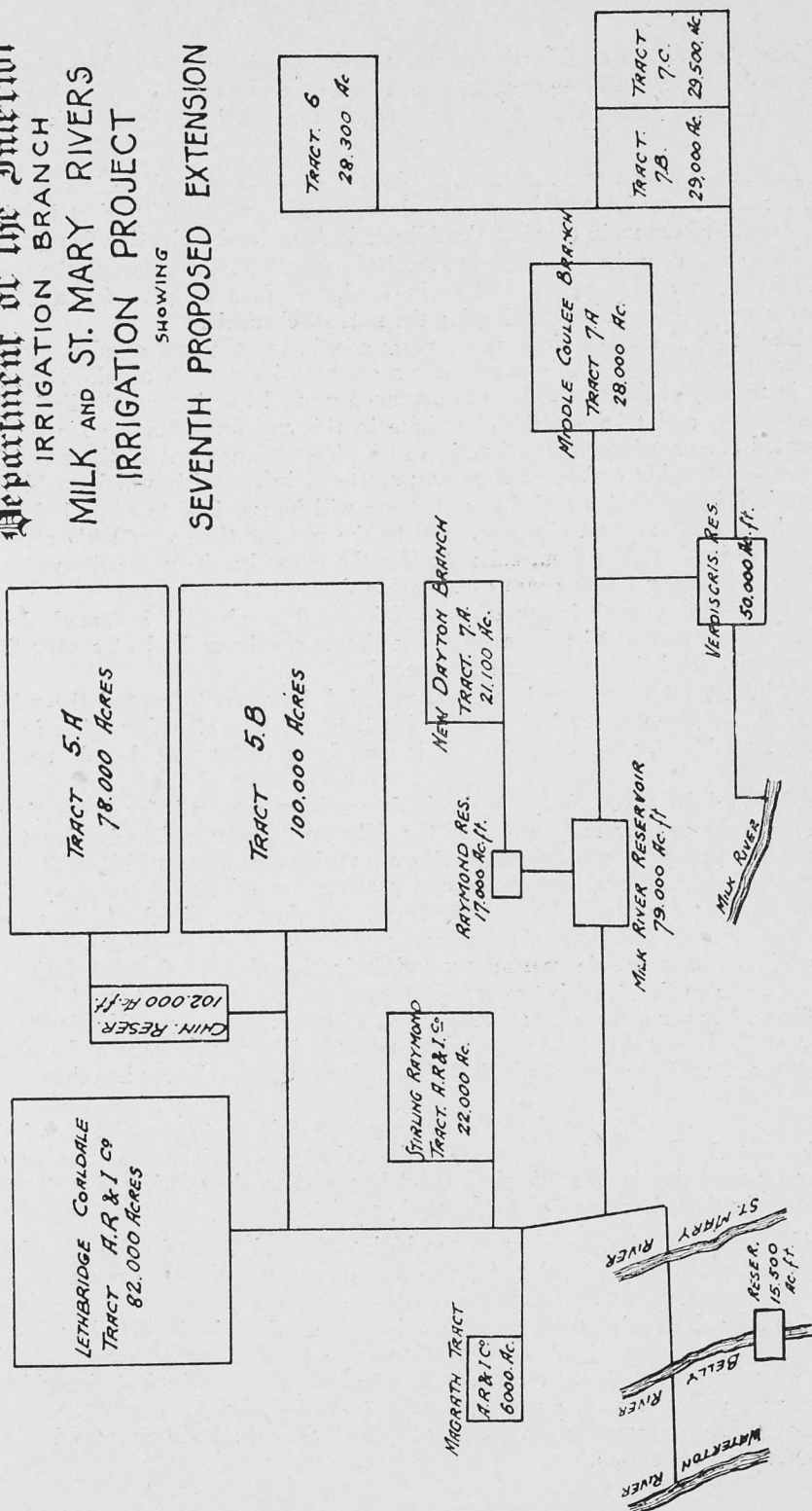
IRRIGATION BRANCH

MILK AND ST. MARY RIVERS

IRRIGATION PROJECT

SHOWING

SEVENTH PROPOSED EXTENSION



The above seven combinations or so-called extensions have all been investigated in some detail. Needless to say, however, there are many other combinations of tracts possible which have not been investigated as yet, owing principally to lack of sufficient data.

Enlargement of the A. R. & I. Main Canal.—The most difficult and uncertain of the estimates which had to be made in connection with this project has been the enlargement of the main canal of the Alberta Railway and Irrigation Company.

There was very little information available from which to estimate the excavation throughout the graded portions of their canal, and practically no information from which to estimate the cost of enlarging the natural channels.

The original cross-sections, made years ago, before the first canal was excavated, cover only a sufficient width to estimate a comparatively small canal. It was necessary in making the estimates here to assume a ground line beyond the limits of their cross-sections and take out the quantities in this manner, allowing for the present estimated cross-sectional area of main canal. The enlargement of the natural water courses was roughly estimated from any scattered information which could be used.

It is believed that a series of structures will be required to control the velocity throughout these natural channels. Up to the present time very little attempt has been made in that direction, and naturally the effect has been for the water to cut badly and in many places cause considerable damage to property.

There is not enough information available to determine the best methods of controlling this water, and before a reliable estimate can be arrived at a very thorough study of the conditions will have to be made.

Estimates for structures have been provided, however, to control the velocity in the whole length of natural channels, with the exception of a few miles in Pothole coulee, township 5, range 22, where it is considered that no further damage can be done.

It should be noted that, on the basis we have assumed for computing canal capacities, the present main canal of the Alberta Railway and Irrigation Company is not large enough to serve the 110,000 acres we have assumed will be irrigated from it. Nevertheless, in arriving at the cost per acre for construction none of the cost has been charged against that 110,000 acres. Furthermore, it should be noted that we have assumed a uniform duty of water and rate of distribution over the entire project including the Alberta Railway and Irrigation Company's tract. The present duty of water on that tract is two acre-feet per acre, whereas the duty we have assumed is 1.5 acre-feet per acre. Our maximum rate of flow, however, provides for the application of 12 inches during the period of greatest demand, in June and July, while the system of uniform flow on which their canals are based calls for less than 10 inches during that same period.

These differences in so far as they may affect the water supply, the design of canals, and the distribution of cost can be adjusted when the construction of any particular extension is determined upon. They need not be considered in the present estimates further than to point out that they exist.

Alternative Route.—In view of the high estimated cost of enlarging the main canal of the Alberta Railway and Irrigation Company's system, the question of an alternative route naturally presents itself.

The only alternative route known, at the present time, is the Whiskey Gap route, investigated in the year 1914, by which it was proposed to carry water from the St. Mary river by a canal through Whiskey Gap to Milk river, again diverting this water, together with the Milk river water, at a point in township 2, range 17, west of the 4th meridian, and carrying the combined capacity to the Milk river and Raymond reservoirs for distribution.

The cost of this route from the St. Mary river to the Milk river reservoir was estimated at \$2,300,000, whereas the cost of carrying the same amount of water by way of the Alberta Railway and Irrigation Company's canal to the Milk river reservoir would be less than \$1,000,000. When we add to this the uncertainties involved in tunnelling through Whiskey Gap, where it appears likely that quicksand and other treacherous materials may be encountered, it is evident that the Whiskey Gap route is not feasible.

Reservoirs.—The following table gives a summary of the estimates of the capacity and cost of the various reservoirs which have been studied.

Name.	Location W. 4th M. Tp. Rge.	Flooded Area in Acres.	Capacity in Acre- Feet.	Total Cost.	Cost per Acre-Foot.
				\$	\$ cts.
Belly river lakes reservoir	In U.S.	977	15,500	15,500	1.00
Belly river reservoir	2-28	625	7,700	365,931	47.53 (a)
Milk river reservoir	5-19 and 20	2,310	79,000	310,360	3.94
Raymond reservoir	5-20 and 21	892	17,000	184,303	10.85
Chin reservoir	7, 8 and 9- 17 and 18	3,000	85,000	118,333	2.62 (b)
Verdigris reservoir	3 and 4-15 and 16	3,535 1,950	102,000 9,000	171,733 41,020	2.76 (b) 4.56
		2,000	21,000	46,469	2.21
		2,400	37,000	66,062	1.80
		2,500	50,000	79,120	1.58

(a) The cost of this reservoir is included in the cost of the Belly river diversion canal in the estimate of Extension No. 6.

(b) The cost per acre-foot of Chin coulee reservoir is based on the additional development above the present capacity of 40,000 acre-feet. Estimate includes cost of feeder canal from section 13, township 8, range 19, west of the 4th meridian.

The Milk river and the Raymond reservoirs are very fortunately located for the reason that by building a short canal from the Raymond reservoir to Nine Mile coulee the water from them can be turned on to any of the tracts under consideration. According to the distribution of water worked out in connection with these estimates, such a canal is not a necessity and has not been included in the estimates. In order to secure a maximum degree of elasticity in operation however, it would no doubt prove to be very desirable. The estimated cost is \$25,000. With their strategical position with respect to the whole project it is unfortunate that the capacity of these reservoirs is so limited.

The Verdigris reservoir, on the other hand, has almost unlimited possibilities for storage development, but its location is such that only a limited quantity can be utilized. If this condition of cheap storage development existed at the Milk river and Raymond reservoir sites, the cost of the whole project could be materially reduced.

Design of Structures.—The smaller structures have been designed according to the standards adopted for the estimates in connection with the Lethbridge Northern Project. It was necessary however, to make designs and estimates of a great many larger or special structures, such as intakes, waste gates, division gates, drops, syphons and flumes for the main canals and branches. Sketches or outline plans were made for these and have been filed with the Commissioner of Irrigation. It has been our purpose to provide for substantial, though not elaborate structures, and to be fairly liberal in estimating costs.

The dams on the Belly and Waterton rivers are to be concrete, similar in design to the one proposed for the Lethbridge Northern Project on the Oldman river. On the Milk river a timber pile dam is proposed.

Unit Costs.—The following unit costs have been used in these estimates:—

Excavation (Canals)—20 cents per cubic yard.

Borrow (Canals)—20 cents per cubic yard.

Excavation (Wet)—40 cents per cubic yard.

Embankment (Earth dams)—30 cents per cubic yard.

Plain concrete from \$9 to \$13 per cubic yard (depending on location).

Reinforced concrete from \$21 to \$27 per cubic yard (depending on location).

Timber construction—\$50 per M. feet B.M. (in place).

Round pile—45 cents per lineal foot (in place).

Milled staves for syphons—\$60 per M. Feet B.M. (in place) (not including haul).

Steel bands for syphons—6 cents per pound (in place) (not including haul).

Haul—40 cents per ton mile.

Riprap—from \$1.50 to \$2 per cubic yard (depending on location).

Stripping—10 cents per square yard.

Puddling—75 cents per cubic yard.

Right of way—from \$10 to \$40 per acre.

In regard to excavation and borrow, it is realized that a unit price of twenty cents per cubic yard is not sufficient for portions of the work. On the other hand there will be other portions such as excavation for small laterals which will cost less than twenty cents per cubic yard.

It is believed that the estimated quantities of excavation and borrow are high and that upon actually locating the various canals, by giving proper attention to the balance of cut and fill, the amount of earthwork will be materially reduced.

It will be realized that all estimates of cost and acreage are based on preliminary surveys only, and hence can be neither exact nor complete. The results of our investigations however, have been compiled in a manner which we hope will be most useful to anyone who may undertake to carry the investigations out in more detail, and we believe that they are as reliable as they can be made with the information now available.

EASTERN SECTION CANADIAN PACIFIC RAILWAY IRRIGATION BLOCK.

The inspection of the irrigable lands in the Eastern Section of the Canadian Pacific Railway Company's Irrigation Block, begun in 1913, was completed in 1916. The work was under the supervision of the Assistant Chief Engineer, with J. S. Tempest as Engineer in charge.

Field Work, 1916.—During the season a gross area of 130,240 acres was inspected. Of this total 92,471 acres are irrigable according to the Canadian Pacific Railway Company's classification. Owing to certain questions of drainage being undetermined, and the results of soil analyses not being completed at the date of this report, the final irrigable area cannot yet be given.

Soil Tests.—Much attention has been given to the examination of the soil, with a view of determining its suitability for irrigation, particularly with reference to alkalinity. Seven hundred and five groups of soil samples have been taken, five hundred and twenty-three of which were taken during the season of 1916. There were usually four samples to a group, extending to a depth of five feet. All except nine of these groups were tested in the field with the electrical bridge, making about two thousand eight hundred samples tested in that manner. Two hundred and fifty-

nine groups or more than one thousand samples have been sent to Ottawa for chemical analysis.

Drainage.—The question of drainage has also been given consideration. Some areas included in the irrigation block are very flat and have insufficient natural drainage. Where the company has not already provided drainage facilities the matter has been called to their attention and will be investigated by them. Our classification in such cases cannot be determined until their plans for drainage ditches are made known.

Operation.—Water was delivered to a few farmers in the Eastern Section during the year and about 20,000 acre-feet was stored in lake Newell.

WESTERN SECTION, CANADIAN PACIFIC RAILWAY IRRIGATION BLOCK.

No field work in connection with the Western Section was carried on during the year. Mr. G. N. Houston, Chief Field Engineer, completed his final report on the reclassification of the irrigable lands and left the service of the department in September, 1916. A considerable amount of office work in connection with the checking and filing of water agreements and the issuing of classification certificates has been carried on under the direction of the Assistant Chief Engineer.

THE ALBERTA RAILWAY AND IRRIGATION COMPANY.

A small amount of improvement work and reconstruction has been in progress during the year. The system has been operating as usual.

THE SOUTHERN ALBERTA LAND COMPANY.

The reconstruction of the main diversion dam, damaged by floods in 1915, was completed from the north end of the dam across and beyond the damaged portion where a temporary connection was made with the south end of the old dam. It is proposed at some later date to extend the new part the balance of the distance to join the sluice-gate structure on the south bank of the river.

Aside from the repair work at the dam no construction was undertaken during the year.

DUTY OF WATER AND IRRIGATED CROP REPORTS FOR 1916.

A complete report of this work has been submitted separately,¹ and the summary below merely outlines the scope of the work which was carried out and deals very briefly with the more interesting features of the duty of water work at Strathmore, Ronalane, and Coaldale, all in the province of Alberta, and submits for record the bare details of the most important information gained.

Experimental plot work on the proper duty of water was carried out at Strathmore and Ronalane; data regarding the duty of water were collected at Coaldale, near Lethbridge, and irrigated crop reports were submitted by the inspecting engineers for the Cypress Hills district mainly in Saskatchewan, and for the Calgary district in Alberta.

It is to be pointed out that there is a very clear distinction between the work which has been done in the various districts. At Strathmore and Ronalane, experimental plot work is carried on. At these places the same crop is grown on several plots under exactly similar conditions of soil, preparation, and seeding. Water is applied to these plots in varying quantities, and the difference in results is then, in so far as it is possible, definitely known to be due to this one element. At the other places it is only possible to collect and compile data showing what results have been

¹ Not printed.

gained by different farmers irrigating their land, and the difference in results cannot always be definitely compared, because of differences in soil conditions and cultural methods between the different fields.

A very considerable and important extension to the duty of water investigations was made this year in carrying out careful soil moisture investigations. It has been found that in order to know just how much water is actually used by the crops, it is necessary, in addition to measuring the rainfall and the irrigation water, to determine the amount of available water held in the soil within the feeding ground of the root system both at the beginning and at the end of the season. A great many soil moisture tests were made and the data thus gained have been incorporated in the reports submitted.

DUTY OF WATER PLOTS, STRATHMORE, ALBERTA, 1916.

Investigations carried out exhaustively during 1915 and 1916 have proved that over a considerable portion of the Strathmore plots the ground water table rises so high that the plant roots penetrate to it. This renders the plots unsuitable for duty of water experiments, because with the plant roots tapping this supply of water it is impossible to determine what quantity is actually used by the plants. It is the intention to turn the Strathmore plots into a demonstration station and develop new duty of water plots at Brooks, during the season of 1917.

The season of 1916 was another "wet" year, the precipitation from April to September being 1.33 feet or 1.25 inches less than in 1915. Because of the plentiful precipitation no irrigation was necessary during 1916. In order, however, to record complete all the information that has been collected at Strathmore, the data covering the three years' work have been summarized in the following table. In this table has been inserted the total depth of water used for crop growth which produced the best yield in each year. The mark ^x denotes that the actual quantity of water used has been determined by soil moisture tests. The mark ^o denotes that the quantity should in all probability be greater, as the soil water was no doubt greatly reduced between seeding and harvest, in addition to using all the rainfall.

SUMMARY OF DATA OBTAINED BY DUTY OF WATER INVESTIGATIONS AT STRATHMORE PLOTS, 1914, 1915 AND 1916.

Year.	Crop.	Duty of Water.	Precipitation between dates of seeding and harvest.	Total depth used which produced the best yield in each year.	Yield per acre.
			In feet.		
1914.....	Alfalfa.....				(Hailed) seeded in spring.
1915.....	".....	0.00	1.23	1.23	3.88 T.
1916.....	".....	0.00	1.06	1.36 x	4.64 T.
				1.295	
1914.....	Red Clover.....				Seeded in 1914.
1915.....	".....	0.00	1.23	1.23	4.02.
1916.....	".....	0.00	1.30	1.30	1.15 T. and 2.5 bu. seed per acre.
				1.265	
1914.....	Wheat.....	0.33	0.62	0.95 o	50.1 bu.
1915.....	".....				Hailed out in 1915.
1916.....	".....	0.00	1.27	1.48 x	45.2 bu.
				1.215	

SUMMARY OF DATA OBTAINED BY DUTY OF WATER INVESTIGATIONS AT STRATHMORE PLOTS, 1914, 1915 and 1916—*Continued.*

Year.	Crop.	Duty of Water.	Precipitation between dates of seeding and harvest.	Total depth used which produced the best yield in each year.	Yield per acre.
1916.....	Oats.....	0.00	In feet. 1.30	1.30	133.4 bu.
1916.....	Barley.....	0.00	0.99	0.99 o	90.5 bu.
1914.....	Peas.....	0.40	0.71	1.11	40.3 bu.
1915.....	“.....	0.00	1.29	1.10 x	Hailed.
1916.....	“.....	0.00		1.105	53.2 bu.
1914.....	Potatoes.....	0.40	0.86	1.26	353.0 bu.
1915.....	“.....	0.00	1.20	1.20	216.0 bu. Hailed.
1916.....	“.....	0.00	1.33	1.33	549.3 bu.
				1.263	
1915.....	Corn.....	0.25	1.02	1.27	4.11 T. Hailed.
1916.....	“.....	0.00	0.89	0.89 o	19.00 T.
				1.08	
1915.....	Turnips.....	0.50	1.23	1.73	9.69 T. Hailed.
1916.....	“.....	0.00	1.15	1.15 o	18.57 T.
				1.44	
1915.....	Timothy.....	0.00	1.10	1.10 o	3.66 T.
1916.....	“.....	0.00	0.85	1.33 x	1.75 T.
				1.215	
1915.....	Brome Gr.....	0.00	0.89	0.89 o	3.14 T.
1916.....	“.....	0.00	0.85	1.39 x	2.84 T.
				1.14	
1915.....	W. Rye Gr.....	0.00	0.89	0.89	2.04.
1916.....	“.....	0.00	0.85	1.21 x	2.76.
				1.050	
1915.....	Mixed Gr.....	0.00	0.89	0.89 o	2.37.
1916.....	“.....	0.00	0.85	0.93 x	3.84.
				0.91	

Total depth used. Average of all crops for 3 years, 1.17 feet.

FIELD DEMONSTRATION PLOTS, STRATHMORE, CARSELAND, AND GLEICHEN DISTRICTS.

It was planned to demonstrate practical irrigation methods and to measure the quantity of water applied to the crops on as many of the fields which were selected for the 1915 work as could be handled. This necessitated the number of plots to be observed being reduced, and as only one field (of alfalfa) was irrigated, the list of plots under observation will not be catalogued as last year. The precipitation from April to September was 1.15 feet at Gleichen and 1.58 feet at Carseland.

	1914.			1915.			1916.		
	Duty of Water.	Precipitation between seeding and harvest.	Total depth rec'd.	Duty of Water.	Precipitation between seeding and harvest.	Total depth rec'd.	Duty of Water.	Precipitation between seeding and harvest.	Total depth rec'd.
Alfalfa.....	1.27	0.71	1.98	0.00	1.36	1.36	0.11	1.32	1.43
Grains.....	0.72	0.71	1.43	0.00	1.06	1.06	0.00	1.18	1.18
All Crops.....	1.08	0.71	1.79	0.00	1.30	1.30	0.065	1.26	1.325

The table above shows the average total amount of water used to grow crops on the fields in the Strathmore, Gleichen, and Carseland districts, which were observed in 1914, 1915, and 1916.

For the three years grain crops received an average total depth of 1.22 feet; alfalfa crops received an average total depth of 1.59 feet; all crops received an average depth of 1.40 feet. The figures 1.22 feet for the grains may be considered fairly close to the optimum. The figure 1.59 feet for the alfalfa is probably considerably below the optimum; many farmers relied too much on the rain, and as a consequence their alfalfa fields did not receive enough water. The figure 1.98 feet being the total depth received for alfalfa fields in 1914 would probably be nearer the optimum quantity for alfalfa in this district.

DUTY OF WATER PLOTS, RONALANE, ALBERTA, 1916.

The duty of water investigations at Ronalane were carried out on the same plots as were used in 1915. The following tables contain in detail the results of the 1916 work. On account of winter-killing, etc., the yields from the alfalfa plots are not comparable. The plot producing the best yield, 4.24 tons per acre, received a depth of 3.27 feet. In the wheat and oat plots the best yields have been obtained under a total depth received (irrigation plus precipitation) of 1.82 feet. Where this depth is exceeded there is a decrease in yield. For the barley, the best yield, 55.6 bushels per acre, was produced under a total depth received of 1.77 feet, as this depth was increased the yield was decreased; plot No. 22, which received 2.77 feet, produced only 40.6 bushels. For the peas, the best yield, 53 bushels per acre, was produced with a depth of 2.90 feet; the plot which received only the precipitation, 1.32 feet, produced but 40.8 bushels. For the potatoes, the best yield, 294 bushels per acre, was produced under a total depth of 1.82 feet. The non-irrigated plot produced but 189.5 bushels per acre. For the sugar beets, the highest yield, 11.12 tons per acre, was produced under a total depth of 2.24 feet. The non-irrigated plot produced but 4.53 tons per acre, and when the total depth was increased to 2.71 feet the yield was reduced to 10.80 tons per acre.

Plot No.	Area.	Gross Yield, Tons.	YIELD PER ACRE.		WATER APPLIED PER ACRE.					Total Acre-feet.	Rain-fall April to Sept. incl. (feet).	Total acre-feet per acre.	
			TONS.		DEPTH IN FEET.								
			Total.	1st Crop cut July 10.	2nd Crop cut Aug. 21.	May 19.	July 15.	Aug. 1.	Aug. 7.				Total depth.
1.....	1.08	1.65	1.52	1.15	0.37						1.32	1.32	
3.....	1.06	3.08	2.90	1.79	1.11			(Not irrigated).	0.77	0.77	0.82	2.09	
4.....	1.11	3.60	3.24	1.88	1.36				0.54	0.54	1.32	1.86	
5.....	1.11	3.27	2.94	1.54	1.40			0.50		0.50	0.56	1.82	
6.....	1.06	3.35	3.16	1.55	1.59			0.52		0.52	0.55	1.84	
7.....	1.06	2.46	2.32	1.04	1.27	0.47				0.47	0.50	1.79	
8.....	1.05	2.48	2.36	1.11	1.25	0.51	0.40			0.91	0.97	2.23	
9.....	1.07	3.31	3.10	1.47	1.63	0.53	0.48	0.50		1.51	1.62	2.83	
10.....	1.11	4.24	3.82	1.88	1.93	0.47	0.54	0.48	0.46	1.95	2.16	3.27	
Totals.....	9.71	27.44									7.78		
Averages per acre.....			2.83	1.50	1.33					0.90		2.22	

NOTE.—Winter killing during 1915-16 lack of uniform soil conditions, etc., makes the results, as to duty of water, uncertain, and other plots seeded in 1916, with uniform soil conditions and even stand, will be used for future work.

WHEAT AND OATS.

Plot No.	Area.	Gross yield bush.	Yield per acre.	WATER PER ACRE. (Time and depth of Water.)				Total acre- feet.	Rain- fall April to Sept. incl. (feet).	Total acre- feet per acre.	Remarks.
				July 15.	Aug. 1.	Aug. 2.	Total depth.				
WHEAT (Marquis).											
11.....	0.5	23.5	47.0	.....	(Not irrigated).		.....	.....	1.32	1.32	Only about 50% stand on plots 13 and 14 until after May rains. The wheat on this area, coming late, was badly affected by rust, causing a reduced yield. Wheat plots cropped with peas in 1915.
12.....	0.5	23.9	47.8	.....	0.50		.....	0.50	1.32	1.82	
13.....	0.5	20.7	41.4	.....	0.48		.....	0.48	1.32	1.78	
14.....	0.5	20.6	41.2	0.50	0.42		.....	0.92	1.32	2.24	
Totals.....	2.0	88.7	.....	.....	.....		.....	0.95	.....	.....
Averages.....	.....	.....	44.3	.....	.....		.....	0.63	.....	1.95	
OATS (Abundance).											
15.....	0.5	35.9	71.8	.....	(Not irrigated).		.....	.....	1.32	1.32	Oat plots cropped with wheat in 1915.
16.....	0.5	37.5	75.0	.....	0.50		.....	0.50	1.32	1.82	
17.....	0.5	39.6	79.2	.....	0.50		.....	0.50	1.32	1.82	
18.....	0.5	38.8	77.6	0.42	.....		0.50	0.92	1.32	2.24	
Totals.....	2.0	151.8	.....	.....	.....		.....	0.96	.....	.....
Averages.....	.....	.....	75.9	.....	.....		.....	0.64	.....	1.96	

BARLEY AND PEAS.

Plot No.	Area.	Gross Yield bush.	Yield per acre.	WATER PER ACRE. (Time and depth of Water.)				Total acre- feet.	Rain- fall April to Sept. incl. (feet.).	Total acre- feet per acre.	Remarks.
				May 20.	July 15.	Aug. 1.	Aug. 8.				
BARLEY (Manchury).	19.....	20.6	55.6	0.45	0.45	1.32	1.77	First irrigation of plots 19, 20, 21 and 22 was before seeding, as soil was too dry to germinate seed. All seeded May 25.
	20.....	22.8	45.6	0.45	.....	.....	.....	1.45	1.32	2.77
	21.....	23.7	47.4	0.45	.....	0.50	0.50	0.93	1.32	2.25
	22.....	20.3	40.6	0.45	.....	0.48	.....	1.45	1.32	2.77
	42.....	12.6	52.5	.....	(Not irrigated).	0.50	0.50	.....	1.32	1.32
Totals.....	2.11	100.00	2.07	
Average.....	47.4	1.11	2.43	
FIELD PEAS (Prussian Blue)	23.....	22.8	45.6	0.50	0.50	1.32	1.82	All pea plots were cropped to wheat in 1915.
	24.....	21.7	43.4	.....	.....	0.50	.....	0.50	1.32	1.82
	25.....	21.3	42.6	.....	.....	0.50	0.50	1.00	1.32	2.32
	26.....	26.5	53.0	.....	0.58	0.50	0.50	1.58	1.32	2.90
	41.....	5.3	40.8	.....	(Not irrigated).	.....	.....	.....	1.32	1.32
Totals.....	2.13	97.6	1.79	
Averages.....	45.8	0.89	2.21	

POTATOES AND SUGAR BEETS.

Plot No.	Area (acres).	Gross yield bush.	Yield per acre.	IRRIGATED. (Time and Depth of Water.)					Total acre- feet.	Rain- fall April to Sept. incl. (feet).	Total acre- feet per acre.	Remarks.	
				May 20.	Aug. 1.	Aug. 7.	Aug. 25.	Total.					
POTATOES (Gold Coin).													
27.....	0.48	91.0	189.5		(Not irrigated).					1.32	1.32	Plots 31, 32 and 33 cropped to sugar beets 1915. All others cropped to barley 1915.	
28.....	0.68	193.5	284.5			0.51			0.51	0.35	1.83		
29.....	0.70	190.0	271.4			0.49			0.49	0.34	1.81		
30.....	0.50	141.5	283.0			0.50			0.50	0.25	1.82		
31.....	0.25	73.5	294.0				0.50		0.50	0.12	1.82		
32.....	0.25	72.0	288.0			0.50			0.50	0.13	1.82		
33.....	0.28	80.4	287.1		0.47		0.50		0.97	0.27	2.29		
34.....	0.50	127.0	254.0		0.50		0.50		1.00	0.50	2.32		
Totals.....	3.64	968.9								1.96			
Averages.....			266.18						0.62		1.94		
SUGAR BEETS (KL. Wanz- leben V).													
35.....	0.15	Tons. 0.68	Tons. 4.53		(Not irrigated).						1.32	First planting May 2, and soil was too dry to germinate seed. May 20 plots were irrigated. Disked, harrowed, and re-seeded May 24. Plots 36, 37, 38 were cropped to potatoes in 1915. Plot 35 was cropped to barley in 1915.	
36.....	0.25	2.61	10.44	0.42			0.50		0.92	0.23	2.24		
37.....	0.25	2.78	11.12	0.42			0.50		0.92	0.23	2.24		
38.....	0.29	3.13	10.80	0.42	0.47				1.39	0.40	2.71		
Totals.....	0.94	9.20								0.86			
Averages.....			9.78						1.09		2.41		

In the following table, that total depth of water received which produced the maximum yield in each year, for each crop, has been tabulated. Throughout the table are given the means for each crop for 1914-15 and 1916. This mean total depth received runs from 2.04 feet for wheat to 2.73 feet for alfalfa.

Summary of data obtained by duty of water investigations at Ronalane, Alberta, for 1914, 1915 and 1916.

Year.	Crop.	Duty of Water.	Precipitation April to September.	Total depth received which produced max. yield in each year.	Yield per acre.	Remarks.
1915.....	Alfalfa.....	1.41	0.93	2.20	4.41 tons.	
1916.....	".....	1.95	1.32	3.27	4.24 "	
				2.73		
1915.....	Wheat.....	1.34	0.93	2.27	49.3 bu.	
1916.....	".....	0.50	1.32	1.82	47.8 "	
				2.04		
1915.....	Oats.....	2.07	0.93	3.00	108.3 bu.	
1916.....	".....	0.50	1.32	1.82	79.2 "	
				2.41		
1915.....	Barley.....	1.96	0.93	2.89	48.6 bu.	
1916.....	".....	0.45	1.32	1.77	55.6 "	
				2.33		
1915.....	Peas.....	0.85	0.93	1.78	24.7 bu.	
1916.....	".....	1.58	1.32	2.90	53.0 "	
				2.34		
1914.....	Potatoes.....	2.92	0.38	3.30	183.15 bu.	
1915.....	".....	1.10	0.93	2.03	408.0 "	
1916.....	".....	0.50	1.32	1.82	294.0 "	
				2.38		
1914.....	Sugar Beets.....	2.56	0.38	2.94	11.82 tons.	
1915.....	".....	0.62	0.93	1.55	16.00 "	
1916.....	".....	0.92	1.32	2.24	11.12 "	
				2.24		
	Average.....			2.35		

DUTY OF WATER—COALDALE, ALBERTA, 1916.

The work at Coaldale was carried on during 1916 in the same manner as in 1915. Owing to the abundant rainfall only a few alfalfa and timothy fields were irrigated. No grain fields were irrigated by the farmers. A small patch of land consisting of 1.95 acres was placed at our disposal by the Canadian Pacific Railway Company. This tract was sown to wheat and oats. The wheat had an area of 0.98 of an acre, the oats 0.97 of an acre. Each tract was subdivided into several plots with the idea of applying varying amounts of water to each. The rains kept the land at an optimum moisture content all season, so it was not necessary to irrigate. However, in order to ascertain definitely the optimum amount, one portion of each tract received a 6-inch irrigation, July 15 to 17. In both instances the plot which was irrigated produced less grain than the balance of the tract which received no irrigation. This indicates that the precipitation of 14.56-feet was sufficient for the needs of the grain crop and that the added 6-inch irrigation made the land too wet and reduced the yield. The tabulated results of the 1916 work are noted in the following table:—

DUTY OF WATER TRACTS — COALDALE, ALBERTA, 1916.

Crop.	Acres.	Irr. No.	IRRIGATION.				ACRE-FEET.				Duty of water.	Pre-cipitation.	Total depth of water.	Yield per cutting.	Yield per acre.
			Date.		Duration	Avr'g Head	Supplied.	Wasted.	Used.	Per acre used.					
			Began.	Ended.											
302 Alfalfa.....	30.0	1 2	May 15 July 13	May 19 July 17	hrs. 107 101	c.f.s. 2.93 4.38	25.88 36.59	1.50 6.09	24.38 30.50	0.81 1.02	1.83	1.56	3.39	1.17 1.24 0.50	2.91 tons.
304 Alfalfa.....	34.0										0.00	1.56	1.56	1.91	3.18 "
315 Alfalfa.....	50.0										0.00	1.56	1.56	1.33	2.69 "
314 Alfalfa.....	50.0										0.00	1.56	1.56	1.37	2.60 "
313 Alfalfa.....	50.0										0.00	1.56	1.56	1.46	2.46 "
312 Alfalfa.....	50.0										0.00	1.56	1.56	0.95 0.56	1.51 "
310 Alfalfa.....	19.7										0.00	1.56	1.56	1.73	2.48 "
306 Alfalfa.....	43.2	1	July 26	Aug. 2	170	2.81	39.70	6.68	33.02	0.76	0.76	1.56	2.32	1.45	3.19 "
305 Alfalfa and Timothy.....	23.5	1	Aug. 2	" 13	217	1.86	33.31	7.66	25.65	1.09	1.09	1.56	2.65	1.39	2.63 "
303 Timothy.....	22.5	1	May 26	May 29	68	1.49	8.39	0.00	8.39	0.37	0.37	1.56	1.93	1.24	1.00 "
316 Timothy.....	100.0	1	" 18	" 21	83	4.20	28.81	0.00	28.81	0.29	0.29	1.56	1.85	0.55	0.55 "
307 Barley.....	78.3										0.00	1.56	1.56	.....	36.00 bush.
309 Barley.....	26.0							0.00			0.00	1.56	1.56	.....	57.00 "
311 Barley.....	33.0										0.00	1.56	1.56	.....	30.00 "
308 Wheat.....	50.0										0.00	1.56	1.56	.....	25.00 "
317 G.H. Wheat.....	0.22	1	July 17	July 17 2h. 12m.		0.60	0.11	0.00	0.11	0.50	0.50	1.56	2.06	.....	49.80 "
317 Wheat.....	0.76										0.00	1.56	1.56	.....	54.00 "
318 G.H. Oats.....	0.21	1	" 15	" 15 2h. 8m.		0.60	0.11	0.00	0.11	0.50	0.50	1.56	2.06	.....	108.00 "
318 Oats.....	0.76										0.00	1.56	1.56	.....	112.30 "
Average for 19 tracts.....											0.28	1.56	1.84		

TABLE SHOWING TOTAL DEPTH OF WATER USED ON COALDALE FARMS, 1913 TO 1916 INCLUSIVE FOR THE DIFFERENT CROPS.

	1913.			1914.			1915.			1916.		
	Duty of Water.	Pre-cipitation.	Total Depth Rec'd.	Duty of Water.	Pre-cipitation.	Total Depth Rec'd.	Duty of Water.	Pre-cipitation.	Total Depth Rec'd.	Duty of Water.	Pre-cipitation.	Total Depth Rec'd.
Alfalfa.....	1.70	0.98	2.68	2.11	0.57	2.68	0.68	1.32	2.00	0.41	1.56	1.97
Timothy.....	0.85	0.98	1.83	.....	.....	.....	1.28	1.32	2.60	0.33	1.56	1.89
Wheat.....	0.74	0.98	1.72	Destroyed by worms	.....	.....	0.22	1.32	1.54	0.00	1.73	1.73
Oats.....	.....	.....	.....	1.49	0.57	2.06	0.00	1.32	1.32	0.00	1.73	1.73
Barley.....	.....	.....	.....	1.25	0.57	1.82	0.00	1.32	1.32	0.00	1.56	1.56
Average for all crops.....	1.15	0.98	2.13	1.84	0.57	2.41	0.57	1.32	1.89	0.28	1.56	1.84

The table above shows the average total depth of water received (irrigation plus precipitation) for all the Coaldale plots, for 1913, 1914, 1915, and 1916. The average total depth of water received by the grain plots for four years is 1.70 feet, the average duty of water for same for four years is 0.59 foot. For the alfalfa and grasses the average total depth received for four years is 2.28 feet, the average duty of water for same is 1.17 feet.

For all the plots, grasses, alfalfa, and grains the average total depth received for four years is 2.07 feet. The average duty of water for four years is 0.96 foot. It will be noted that during 1913 and 1914 the duty of water and total depth received are greater than for the two wet years 1915 and 1916.

DISCUSSION OF SUMMARIZED DATA.

The natural precipitation varies greatly from year to year and directly affects the duty of water. In dry years a greater depth of irrigation is required than in wet years. The clearest way to view the matter is to consider both natural precipitation and irrigation water simply as so much depth of water applied to the crops. Then by adding together natural precipitation and irrigation we get the total depth of water applied, and thus have a figure which is readily comparable from year to year. This latter statement must not be accepted absolutely, because the seasonal distribution of the precipitation and temperature also has a marked effect on the crop growth. It must also be always kept in mind that soil and subsoil conditions have a very marked effect on the duty of water, so that in comparing results gained at different places many conditions must be considered to get a true perspective.

The first table below is inserted to show the climatic conditions for the three years 1914, 1915 and 1916, at the three stations from which data have been taken in writing the general discussion on duty of water for several crops which follows. The second table is inserted for purposes of comparison showing the average climatic conditions which prevailed during the three years as compared with long term averages. In both cases the period April to September both inclusive is used.

	PRECIPITATION.			TEMPERATURE.		
	1914.	1915.	1916.	1914.	1915.	1916.
	Feet.	Feet.	Feet.	° F.	° F.	° F.
Strathmore.....	0.71	1.44	1.33	52.4	52.6	52.3
Ronalane.....	0.38	0.93	1.32	59.4	57.1	55.2
Coaldale.....	0.57	1.32	1.56	55.9	55.4	54.5

	PRECIPITATION.		TEMPERATURE.	
	1914-1916.	Long Term.	1914-1916.	Long Term.
	Feet.	Feet.	° F.	° F.
Calgary.....	0.94	1.06	54.3	52.3
Medicine Hat.....	0.90	0.78	59.7	58.7
Lethbridge.....	1.14	0.99	54.7	55.8

Calgary — index for Strathmore — long term records, 1885-1916.

Medicine Hat — index for Ronalane — long term records, 1884-1916.

Lethbridge — index for Coaldale — long term records, 1903-1916.

The following chart is included to indicate the different soil conditions at Strathmore, Ronalane and Coaldale.

DIAGRAM
Showing Typical Soils of
STRATHMORE, RONALANE & COALDALE. (near Lethbridge)

DEPTH IN FEET	STRATHMORE	RONALANE	COALDALE
0	Sandy Soil	Fine Sandy Loam Soil	Clay Loam
1	Fine Sandy Soil	Sandy Loam	Light Clay Loam
2	to depth Varying from		very Uniform
3	3 to 7 Feet		has no Impervious Strata
4	Heavy Clay and Gumbo	Sand and Gravel	
5	Subsoil very Impervious		
6			

Note:- The soil in the Gleichen and Carseland districts is practically of the same general structure and texture as at Strathmore

In considering the final discussion hereunder it must be borne in mind that the proper depths of water indicated are only tentative. The desire is to indicate as truly as possible the proper depths based on the incomplete data now available. Even with this understanding it is extremely difficult to discuss any feature definitely because one has to deal with a maze of figures and many special conditions arising in the practical work, all of which will affect the cataloguing of true conclusions unless

the greatest caution is exercised. For instance, in the summary table the average depth producing the best yield of wheat at Ronalane is shown as 2.04 feet. This is arithmetically correct based on the rule of the best yields produced each year. But a close study of the detail tables for 1915 and 1916 shows that the maximum yield produced was very little greater than some other yields produced with a considerably less depth of water. In other words the extra expense of the added irrigation was not warranted by the small increase in yield. In preparing the discussion below the writer has used the greatest license, after a careful study, in adopting the data which in his opinion first show a true comparison and secondly stand the test of practical and economical usage.

In all cases in the discussion hereunder the natural precipitation quoted is for the period April 1 to September 30.

WHEAT.

At the Strathmore plots during 1914, 1.04 feet produced 50 bushels; during 1915, 1.44 feet produced bumper crops in the surrounding district; during 1916, 1.48 feet produced the best crop of 45 bushels. These figures indicate that for Strathmore a depth of 1.5 feet is ample.

At Coaldale, during 1914, the natural precipitation of 0.57 foot produced a crop failure; during 1915, the natural precipitation of 1.32 feet produced bumper crops; during 1916, the natural precipitation of 1.56 feet produced better results than a depth of 2.06 feet. These figures indicate that again for Coaldale a depth of 1.5 feet is ample.

At the Ronalane plots during 1915, the natural precipitation of 0.93 foot produced 42 bushels. The irrigated plots with increased depths varying up to 2.27 feet produced varying yields up to 49.3 bushels. In this case it seems fair to adopt the mean of all the irrigated plots, which gives 1.70 feet. During 1916 the mean of the two plots which are comparable and produced practically the same yield of 47 bushels, gives a depth of 1.60 feet. At the Ronalane plots one finds gravel and sand at a depth of about 3.5 feet, so that the soil has a very low water holding capacity.

Judging from the figures quoted it still appears that a total depth of 1.5 feet is sufficient for wheat.

Oats.

At the Strathmore plots, during 1916, 1.30 feet produced the best yield of 133 bushels.

At Coaldale, during 1914, the natural precipitation of 0.57 foot produced a crop failure; during 1915, the natural precipitation of 1.32 feet produced bumper crops; during 1916, the natural precipitation of 1.56 feet produced better results than a depth of 2.06 feet.

At Ronalane, during 1915, the smallest irrigation given was 0.26 foot, making a total depth of 1.45 feet, which produced 76 bushels. As the irrigation was increased there was a constant increase in yield up to the greatest total depth of 3 feet, which produced 108 bushels. During 1916, a depth of 1.82 feet produced the best crop of 79 bushels. The presence of the gravel strata at a shallow depth makes it difficult to draw conclusions at Ronalane.

Alfalfa.

At the Strathmore plots, during 1915, the natural precipitation of 1.44 feet produced a good crop of 3.88 tons, and additional water did not increase the yield; during 1916, the best crop of 4.64 tons was produced by a total depth of 1.36 feet.

At Coaldale the means for all fields observed from 1913 to 1916 show a total depth of 2.33 feet, producing 3.63 tons. The same two plots commented on in 1915 (numbers 302 and 304), which are old fields that have given good yields consecutively from 1913 to 1916, show an average total depth of 2.40 feet producing 4.10 tons.

At the Ronalane plots, during 1915, the average of two plots producing nearly the same tonnage, shows that a total depth of 2.40 feet produced 2.3 tons; during 1916 the results are not comparable because the yield on the plots was not uniform, due to winter-killing the previous winter. The averages of all the plots would show that a total depth of 2.12 feet produced 2.82 tons. It would appear to be safe to anticipate that a total depth of 2.5 feet will be sufficient for alfalfa.

GRASSES.

At the Strathmore plots, during 1915, the natural precipitation of 1.44 feet produced good crops as follows: Timothy, 3.66 tons; brome, 3.14 tons; Western rye, 2.04 tons; Western rye and brome mixed, 2.37 tons. During 1916 the timothy plot using the most water yielded the best, 1.33 feet producing 1.75 tons; a depth of 1.33 feet produced the best yield of brome, 2.83 tons; a depth of 1.21 feet produced the best yield of Western rye, 2.76 tons; a depth of 0.99 foot produced the best yield of Western rye and brome, 3.84 tons.

At Coaldale during 1915 two fields of timothy seeded in 1914 received 2.72 feet and 2.49 feet, producing 1.50 tons and 1.99 tons respectively; during 1916 these same two fields received 1.93 feet and 1.85 feet, and produced 1 ton and 0.55 ton respectively.

POTATOES.

At the Strathmore plots during 1914 the greatest depth applied was 1.11 feet, which showed a marked increase in yield over the dry crop, producing 353 bushels; during 1915 the potato crop was diseased, which made comparative results unreliable; during 1916 the natural precipitation of 1.33 feet produced a fine yield of 542 bushels.

At the Ronalane plots, during 1914, the plots were all very heavily irrigated, and all the yields were very small, indicating that all the plots were over-irrigated; during 1915 the best results were obtained by using 1.53 feet, producing 393 bushels; during 1916 the best results were gained by using 1.82 feet; five plots received this amount and the average yield was 284 bushels.

FIELD PEAS.

At the Strathmore plots, during 1914, the greatest depth applied was 1.11 feet, which showed a marked increase over the dry crop, producing 40 bushels; during 1915 the plots were badly hailed, making comparison impossible; during 1916 the plots were damaged by strong winds drifting the soil and owing to a backward spring and a wet month of August, neither the irrigated nor the non-irrigated plots were fully matured.

At the Ronalane plots, during 1915, the natural precipitation of 0.93 foot produced 23.3 bushels and irrigation produced no increase; during 1916, 1.32 feet produced a good crop of 41 bushels, and 2.90 feet produced 53 bushels, but intermediate depths of 1.82 feet and 2.32 feet did not show corresponding results, so that comparison is made unreliable.

BARLEY.

At the Strathmore plots, during 1915, the crop was spoiled by hail; during 1916 the natural precipitation of 1.33 feet produced an average of 46.3 bushels on eight plots which had not been manured, while the average for two manured plots increased to 86 bushels.

At the Ronalane plots, during 1915, the natural precipitation, 0.93 foot produced 60 bushels on summer fallow, and additional depths decreased the yield; during 1916, 1.32 feet produced 52.5 bushels, 1.77 feet produced 55.6 bushels, while additional depths decreased the yield.

SUGAR BEETS.

At the Strathmore plots, during 1915, the stand obtained was poor and uneven, but the results indicate the natural precipitation of 1.44 feet produced as well as any irrigated plot; during 1916 the beets were in low wet ground and again produced a very poor crop.

At the Ronalane plots, during 1915, the best crop was produced by 1.55 feet, yielding 16 tons; during 1916 the plots are not properly comparable, but the results indicate that a depth of 2.24 feet was ample, if not too much.

EVAPORATION FROM A FREE WATER SURFACE.

This data was collected in the same manner as described in the 1915 report.

STRATHMORE, ALBERTA.

	TOTAL EVAPORATION, IN INCHES.		MEAN DAILY EVAPORATION, IN INCHES.	
	1915.	1916.	1915.	1916.
April.....	4.22	2.59	0.141	0.086
May.....	4.73	3.46	0.153	0.111
June.....	4.33	4.59	0.143	0.153
July.....	6.47	4.84	0.209	0.156
August.....	4.25	3.16	0.137	0.102
September.....	2.27	2.66	0.076	0.088
October.....	1.78	1.02	0.059	0.033
Total.....	28.05	22.32		

COALDALE, ALBERTA.

	TOTAL EVAPORATION, IN INCHES.		MEAN DAILY EVAPORATION, IN INCHES.	
	1915.	1916.	1915.	1916.
April.....	5.68	1.51	0.189	0.050
May.....	4.28	5.12	0.138	0.165
June.....	2.26	4.68	0.075	0.156
July.....	4.38	6.20	0.141	0.200
August.....	4.97	4.70	0.160	0.151
September.....	2.93	3.59	0.098	0.119
Total.....	24.50	25.80		

CROP REPORT—CYPRESS HILLS DISTRICT.

Mr. M. H. French reports as follows on the crop conditions during 1916 in this district.

"The season was, on the whole, quite favourable to crop growth, and some very large yields were reported, although the average for the district was lower than that of the previous year. This combination of good crops with high prices produced very high money returns to the farmers and again reveals the latent possibilities of our western soil, when the moisture conditions are favourable. It only remains for men, when possible, to reproduce these conditions artificially, and as a consequence, to reap to a greater or less degree similar crops.

In the spring, the moisture conserved in the soil from the previous season was ample to start nearly all crops, while the precipitation throughout the growing season kept them in a thrifty condition. The moisture may have been slightly excessive for grain upon heavy lands, for the maturing of these crops was delayed dangerously late in the summer. The first damaging frost occurred September 13, but did no damage to the grain below an altitude of 3,000 feet, which had already been cut and stooked. A large part of the grain grown above that altitude was slightly frosted, while some near the west end of the Cypress hills was injured by a frost in August.

Considerable damage was done to the wheat, at the higher altitudes, by black rust, but very little to the wheat at the lower altitudes. In no instance, to my knowledge, was a crop injured to such an extent as to render it not worth the cutting. During the latter part of the season, haying, harvesting, and threshing operations were seriously delayed by rain and snow.

The amount of water applied to the land this season, apart from the natural watering of hay meadows by overflow of creeks, was very little. The reason in almost every case for the non-use of water was attributable to the supply of moisture available from precipitation. However, certain irrigators applied water to their lands with apparent increased yields.

Mr. Frank Cross, near East End, Sask., irrigated his hay meadow during the early summer with the noticeable result of an increased growth in those portions of the meadow irrigated, over those portions not irrigated. The altitude of this field is about 3,200 feet and the soil is heavy and slightly alkaline.

Mr. Earl Nash, near Nashlyn Post Office, Sask., flooded a 40-acre field of alfalfa, by the dyking system, with excellent results. The crop was ready for cutting July 5, and there was sufficient moisture in the soil to mature another heavy crop. This field is about 2,800 feet above sea-level, and the soil is a heavy clay.

Perhaps the greatest results from irrigation last season were obtained from the lighter soils where the sub-surface drainage is good. An excellent example of the benefits to be derived from a judicious application of water is no better illustrated anywhere than upon the irrigated field of Messrs. Starks and Burton, southeast of Medicine Hat. Its luxuriant growth of alfalfa serves as a welcome relief to the eye, after driving for several miles over rolling sun-baked prairie. About 110 acres, of otherwise practically worthless sandy land, have been seeded to alfalfa with inoculation, with the result that an average annual yield of three tons per acre is being obtained. The water supply is extremely variable and unreliable but what there is of it is being utilized. This field lies along either side of the main trail leading south-east of Medicine Hat, and serves as an excellent object lesson to the people travelling through the country, of the growth possible when the rainfall is supplemented by irrigation, even though the water supply may be as uncertain as in the scheme cited above.

The following extract from a letter received from Mr. Francis Wright, a careful observer, and a successful truck gardener near Medicine Hat, shows the advantages of a little water at the opportune time:—

“This land is flooded in the spring before seeding by the furrow and check method. Although having had a wet season, irrigation showed its usefulness for the irrigated grain came up tens days earlier with a 50 per cent better stand than the unirrigated grain, and yield ten bushels per acre more. But the usefulness of irrigation is more demonstrated when small garden seeds are planted, because, where not irrigated, barely 25 per cent of the seeds germinate until the first rain, in which case, if it should not come soon after planting, the seeds are destroyed. Furthermore, even under the most favourable circumstances, I find that the irrigated vegetables are far superior to those grown without irrigation.”

The above field is about 2,500 feet above sea-level, and the soil is a sandy loam with good sub-drainage.

Classification.	North.	East.	South.	West.	Totals.	Percent- age of Irrigated Area.
Irrigated areas in district	18,411	14,955	14,243	16,611	64,220	% 100.0
Cultivated areas in district	1,279	1,587	2,316	1,814	6,996	11.0
Area in wild hay cut	3,757	5,078	1,212	1,599	11,646	18.0
Area in grain	777	935	1,783	1,537	5,032	8.0
Area in timothy	25	159	160	98	442	0.7
Area in timothy and clover	30	140	00	00	170	0.3
Area in bromus	55	209	15	11	290	0.5
Area in western rye	32	31	112	51	226	0.4
Area in alfalfa	224	60	106	55	445	0.7
Area in garden truck	65	30	7	1	103	0.2
Area grazed off by stock	13,375	8,290	10,715	13,198	45,578	71.0

The above table of areas reveals the fact that the larger part of the irrigable area of the district is native grass land, the smaller and better parts of which is being cut for hay and the balance grazed off by stock. Most of this land is watered every year during the spring freshets by the overflowing of the creeks, and by diversions through irrigation ditches, and again in the early summer if heavy rains occur. The lower lands generally receive sufficient moisture from irrigation and precipitation to produce each season good growths of the native grasses such as blue-joint, red-top, and June grass. These lands, however, are prone to run to foxtail, an obnoxious grass caused, as many people claim, by the presence of stagnant water. This grass is very injurious to cattle, and if present in large amounts greatly reduces the selling and feeding value of hay. This is a most serious problem for which irrigators have not yet found a successful solution other than cultivation and re-seeding to tame grass. Probably, like the obnoxious weeds of the dry-land farms, this may be a blessing in disguise since the necessity of its eradication undoubtedly affords a strong reason or incentive for the cultivation of the hay meadows. Sometimes this is done with good results, but generally this pest is endured for a season or two when, for some unexplainable reason, it becomes nearly extinct for a time. The yields from these lower lands average from one to one and a half tons of hay per acre.

Those parts of the hay meadows not so favourably situated as those mentioned above are also irrigated during the spring and possibly again in the summer. Having a greater slope, the water soon runs off, leaving the soil exposed to the winds and direct rays of the sun. This causes an early drying up and maturing of the grass. The yields from these lands are always low and never exceed one ton per acre, the grass being either cut for hay or pastured off by stock.

The reason for the low development of these natural grass lands comprising 89 per cent of the whole is the present ample supply of hay. Generally speaking, these lands are owned by stockmen with comparative large interests who have not experienced a dire lack of hay except during hard winters. It is true that the encroachments of the dry farmers is greatly curtailing the grazing lands, but the stockmen have met this difficulty by reducing their herds and not endeavouring to increase the yields of the hay meadow. This is a state of affairs that will not materially alter for many years, but undoubtedly the further development of the country will ultimately cause an increase in the yields from these lands by means of cultivation and better methods of irrigation.

The land seeded to the cultivated or tame grasses such as timothy, clover, bromus, red-top and western rye comprise a large number of small fields, ranging from small experimental plots to fields of forty acres or more. The growing of tame hay has been undertaken more by the smaller land owners whose meadows are limited, than by the larger land owners whose meadows are still ample for present requirements. The

water supply for these fields is generally greater and more regular than for the wild lay lands mentioned above. These fields require a considerable amount of cultivation and work to develop them, but the returns have almost without exception justified the expense. The yields, each season, vary from one to three tons per acre, depending upon the variety of the crop and length of period which it has been sown.

Bromus seems to be a very popular grass due to its hardiness, good growing and fair feeding qualities. It demands considerable water during the growing season. To prevent it becoming sod-bound, it should be shallow-ploughed in the spring of every fourth year and thoroughly disced. However, fair crops have been observed in fields six years old. *Bromus* yields from one to two tons of hay per acre and the field serves as a good fall pasture.

Western rye and red-top are seldom sown because the former generally becomes woody if not cut at the right time and cured properly, while the latter is not considered a heavy yielder. However, I have seen one or two good fields of western rye grass and red-top is highly recommended for low wet ground which is slightly alkaline.

Several small fields of timothy are noticed here and there while travelling about through the district. Experience evidently proves that this grass requires a steady amount of water throughout the growing season, or otherwise, it becomes stunted, woody and less palatable for horses. This is especially noticeable of timothy grown upon dry lands. The yield of irrigated timothy varies from one to two tons per acre.

The best hay crop for those fields, where the water supply is fairly regular and ample, is a mixture of timothy and alsike clover. The former is a shallow-rooted plant, while the latter is deep-rooted. Hence the growth of one is not seriously affected by the presence of the other. Furthermore, the clover protects the ground from the direct rays of the sun more than the other grasses, and decreases the loss of moisture by surface evaporation. Only two fields have been thus seeded, but have been attended with excellent results in each case. One forty-acre field in its sixth year produced, according to neighbours' estimates, about three tons per acre—the timothy standing 36 inches. The soil concerned is a heavy clay, and the crop was irrigated once or twice during the growing season.

In concluding the remarks upon the cultivated grasses, I wish to state that from six years' observation I have noted that the larger yields of these grasses over the native grasses have always justified the cost of their seeding. It is not absolutely necessary to assume the expense of breaking up the meadow to get grass seed started. I have seen good results obtained by merely scattering the seed upon the sod, which is afterwards thoroughly disced. Alsike clover will often take root along natural water courses, by the seed being carried from the fields above. One person had considerable success scattering the timothy seed upon the snow when it is melting later in the spring. But whatever method is adopted, good results generally follow.

Speaking of alfalfa, the king of forage crops, note from the table that it is but slightly beyond the experimental stage in this district. This crop needs no recommendation other than its own history in the West. It is unquestionably the best crop for any irrigator to grow, if his lands are of an alluvial nature, well drained, smooth and irrigated once or twice during the growing season. Being a deep-rooted plant, it is very drought resisting. Consequently, it is superior in this respect to the cultivated grasses which are shallow-rooted and non-drought resisting. It is slowly becoming more popular as its virtues spread, and it should eventually be grown extensively in many of the valleys.

CROP REPORT—CALGARY DISTRICT.

The crop conditions in the Calgary district were very similar to those described for the Cypress Hills district, but as the bulk of the land in this district is utilized for growing forage, very little irrigation was practised because of the sufficient precipitation.

The crop reports made up for this district, which are not, however, complete, show that the following acreages were irrigated during 1916: Alfalfa, 92; native hay, 335; bromus, 28; timothy, 384; western rye, 120; green feed, 8; garden truck, 1; making a total of 658 acres, as against 1,617 acres reported as having been irrigated during the dry year of 1914.

The following table schedules the acreage in this district devoted to the various crops:—

Classification.	Acres.	Percentage of Irrigable Acres.
		%
Irrigable area in district.....	20,864	100.0
Cultivated area in district.....	7,283	35.0
Area in wild hay cut.....	3,979	19.0
Area in grain.....	3,232	16.0
Area in timothy.....	1,709	8.3
Area in alfalfa.....	987	4.7
Area in brome.....	331	1.6
Area in western rye.....	183	0.9
Area in green feed.....	521	2.5
Area in summer fallow.....	320	0.7
Area not reported.....	11,262	46.0

PRIVATE IRRIGATION DEVELOPMENT.

The bulk of all the private irrigation schemes have been constructed in Alberta and Saskatchewan since 1896, so that the close of 1916 marked two decades of irrigation development of this kind. It was not considered desirable to submit any lengthy discussion under this heading, but certain very interesting data are submitted in tabular form hereunder:—

CONSTRUCTION AND COST TABLE.

District.	AVERAGE.				
	Period Construction Years.	Cost per Irrig. Acre.	Irrig. Acres per Man.	Cost per Man.	Add'n. Dry Acs. per Man.
		\$		\$	
Cypress Hills.....	5	6 40	336	2,150	350
Calgary.....	5	6 40	282	1,805	421
Remainder Alberta and Saskatchewan..	4	6 40	295	1,888	332
Average.....	4½	6 40	316	2,022	363

In the table above the average period of construction was taken for all schemes as between the date of authorization and date of issue of license. The figures for cost per irrigable acre, irrigable acres per man, and additional dry acres per man, have not been taken from exactly the same sets of figures because all of this data was not complete in every case. This will result in the averages not being strictly comparable, but the number of cases used throughout has been so large that there should be no great discrepancy.

In the tables below all irrigation schemes in the districts noted have been listed, showing their distances from railway stations and their suitability for growing grain or only forage. The schedule includes every scheme but does not necessarily represent an equal number of owners, since many irrigators have more than one scheme. To offset this, however, there are a number of schemes in which more than one owner is interested, so that probably the number of schemes represents the number of owners fairly closely.

The table shows for the Cypress Hills district that 77 per cent of all the schemes are suitable for grain and 23 per cent for forage crops only. Also that 80 per cent of the schemes are within twenty miles of a railroad and that no scheme is more than one and one-half days' haul from town. In studying the table it must be remembered that the schemes grow smaller in acreage as they get higher in the hills, and the same condition holds as they get further from the railroads, so that possibly 90 per cent of the total irrigable acreage is within twenty miles of a railway and suitable for growing grain.

For the Calgary district the table shows that 47 per cent of all the schemes are suitable for grain, and 53 per cent for forage crops only. Also that only 33 per cent of the schemes are within twenty miles of a railway.

CYPRESS HILLS DISTRICT.

HAULAGE AND CROP TABLE.

NUMBER OF SCHEMES.

Distance to Railway.	MAIN LINE, C.P.R.		WEYBURN-LETHBRIDGE, C.P.R.		—
	Grain.	Forage.	Grain.	Forage.	
A. 1-10 miles.....	34	0	33	4	
B. 11-20 ".....	21	5	44	5	
C. 21-30 ".....	4	9	2	10	
D. Over 30 miles.....	1	8	0	1	
Totals.....	60	22	79	20	181
A + B.....	55	5	77	9	146
C + D.....	5	17	2	11	35

CALGARY DISTRICT.

HAULAGE AND CROP TABLE.

NUMBER OF SCHEMES.

Distance to Railway.	CALGARY-MACLEOD, C.P.R.		CROWSNEST BR., C.P.R.		—
	Grain.	Forage.	Grain.	Forage.	
A. 1-10 miles.....	9	.....	4	0	
B. 11-20 ".....	8	1	5	0	
C. 21-30 ".....	11	7	0	0	
D. Over 30 miles.....	1	30	0	5	
Totals.....	29	38	9	5	81
A + B.....	17	1	9	0	27
C + D.....	12	37	0	5	54

NOTE.—Contour 3,500 feet above sea-level taken as the line of division between grain and forage crops

All distances are reduced to a level haul basis, one mile over hilly roads being considered equal to two miles of level prairie haul.

Consumption of water for municipal supply for cities and towns in the provinces of Saskatchewan and Alberta.

During the past two years an attempt has been made to obtain more definite and complete records than are at present available of the actual quantities of water being used for municipal purposes in the larger towns and cities in the provinces of Saskatchewan and Alberta.

The objects in view are: (1) to facilitate the efforts of this department in determining the basis of quantity per capita in the issuing of licenses for "municipal purposes" and, (2) to obtain from official returns prepared on standard forms, an analysis of the municipal consumption for the special benefit of public bodies, municipal engineers, etc.

Two years' records have now been obtained for many of the important towns and cities and these have been summarized and analysed with a view to showing the relationship between the quantities which have been used per head, per day, for domestic, industrial and other public purposes.

The branch is indebted to the city engineers, waterworks superintendents and other officials of the respective cities and towns for the data which have been compiled for publication. It is hoped that the compiled data will prove of interest to these officials, and that we may be able to continue and extend the compilation in future years.

LIST OF PUBLICATIONS OF THE IRRIGATION BRANCH.

Annual Stream Measurement Report, 1909 to 1915.

Annual Irrigation Report, 1906 to 1915.

Irrigation Surveys and Inspections Report, 1915; (1915-16); (1916-17).

Western Canada Irrigation Association Report (1st to 10th Convention).

International Irrigation Congress Report (1914).

Bulletin No. 1 (Irrigation in Saskatchewan and Alberta).

Bulletin No. 2 (Alfalfa Culture).

Bulletin No. 3 (Climatic and Soil Conditions, C.P.R. Irr. Block).

Bulletin No. 4 (Duty of Water Experiments and Farm Demonstration Work).

PAMPHLETS:

Address by Mr. S. G. Porter; "Practical Operation of Irrigation Works";
Extract from W.C.I.A. Report, 1914.

" " Dr. Rutherford; "Inter-dependence of Farm and City";
Extract from W.C.I.A. Report, 1914.

" " Mr. Don. H. Bark; "The Actual Problem that Confronts the
Irrigator";
Extract from W.C.I.A. Report, 1914.

" " Mr. Don H. Bark; "Practical Irrigation Hints for Alberta";
Extract from W.C.I.A. Report, 1915.

" " Mr. Don H. Bark; "Alfalfa Growing";
Extract from W.C.I.A. Report, 1915.

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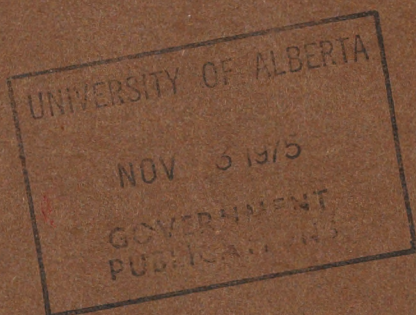
DEPARTMENT OF THE INTERIOR OF CANADA

ARTHUR MEIGHEN, Minister; W. W. CORY, Deputy Minister

Irrigation Branch---E. F. DRAKE, Superintendent

REPORT ON
IRRIGATION SURVEYS
AND INSPECTIONS

1917-18



OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

1919

ROLL OF HONOUR

IRRIGATION BRANCH DEPARTMENT OF THE INTERIOR.

Employees Enlisted for Active Service.

J. W. H. Wilkes	Leveller	Aug. 16, 1914	Lieut. 3rd Brig., R. H. A.
E. S. McMillan	Draughtsman	Aug. 21, 1914	L.-Corp. Div'l Engineers.
W. E. Dow	Draughtsman	Aug. 22, 1914	Bombing Instr. 13th M.D.
C. V. Craik	Engineer	Aug. 22, 1914	Corp. Div'l Engineers.
E. S. Clifford	Hydro Asst.	Aug. 24, 1914	Maj. Asst. Provost Marshal
R. V. Muller	Leveller	Aug. 26, 1914	Tpr. Royal Can. Dragoons
C. E. Vrooman	Leveller	Sept. 26, 1914	Spr. Div'l Engineers
C. P. Maxsted*	Rodman	Sept. 26, 1914	Spr. Div'l Engineers
H. E. Bowden	Teamster	Sept. 26, 1914	Spr. Div'l Engineers
J. S. Ferrier	Draughtsman	Nov. 6, 1914	Lieut. Machine-Gun Corps
H. D. St. A. Smith**	Engineer	Nov. 9, 1914	Maj. Div'l Engineers
C. B. Hornby†	Accountant	Nov. 16, 1914	Maj. 31st Battalion
G. N. Page	Leveller	Nov. 16, 1914	Pte. Army Service Corps
D. C. McDougall	Accountant	Nov. 19, 1914	Q. M. S. Div'l Engineers
G. H. Nettleton	Hydro. Asst.	Jan. 4, 1915	Lieut. Provost Marshal's Staff
N. J. Arnold	Draughtsman	Jan. 28, 1915	Staff Sergt. 175th Bn., C.E.F.
H. S. Kerby	Engineer	Feb. 11, 1915	Maj. R. N. Flying Corps
J. H. Jones	Engineer	Apr. 26, 1915	Capt. Div'l Engineers
E. W. W. Hughes	Engineer	May 8, 1915	Pte. 53rd Battalion
G. R. Elliott	Engineer	Aug. 16, 1915	Lieut. Signallers, Can. Engrs.
W. T. White†	Engineer	Aug. 16, 1915	Maj. 1st Pioneer Battalion
H. W. Cheney	Engineer	Sept. 29, 1915	Lieut. 4th University Co.
N. R. English‡	Rodman	Sept. —, 1915	Pte. 4th University Co.
W. E. Hunter	Accountant	Oct. 2, 1915	Sergt.-Maj. 87th Battalion
E. L. Hornby	Draughtsman	Oct. 12, 1915	Pte. 16th Batt., Can. Scottish
J. Cawthorn	Clerk	Oct. 14, 1915	Co. Q.M.S. 1st Pioneer Battalion
H. B. R. Thompson	Engineer	Nov. 8, 1915	Pte. 1st Pioneer Battalion
F. R. Burfield	Engineer	Dec. 31, 1915	2nd Lieut. Royal Engineers
W. G. Guthrie	Draughtsman	Feb. 20, 1916	Pte. Army Medical Corps
L. E. M. Shenton	Draughtsman	Feb. 24, 1916	Spr. Australian Imp. Forces
W. B. Hutcheson	Engineer	Mar. 13, 1916	Lieut. Royal Flying Corps
H. R. Carscallen	Engineer	Mar. 31, 1916	Lieut. Div'l Engineers
W. R. McCaffrey	Engineer	Mar. 31, 1916	Sergt. Canadian Reserve Cycl.
R. E. Matheson	Hydro. Asst.	Mar. 31, 1916	Spr. Div'l Engineers
P. J. Jennings	Office Engineer	Apr. 1, 1916	Capt. and Adj. 4th Pioneer Bn.
G. H. Whyte†	Divl. Hydro. Eng.	Apr. 4, 1916	Lieut. Div'l Engineers
T. H. Burt	Hydro. Asst.	Apr. 4, 1916	Pte. Army Medical Corps
R. H. Goodchild	Engineer	Apr. 22, 1916	Lieut. 4th Pioneer Battalion
L. J. Gleeson	Engineer	May 9, 1916	Q.M.S. 52nd C.F.A.
F. K. Beach	Engineer	May 21, 1916	Lieut. 8th Constr. Batt.
J. M. Paul§	Engineer	May 22, 1916	Gunr. 72nd Queen's Battery
O. H. Hoover	Engineer	June 15, 1916	Gunr. 67th O. S. Battery
I. R. Strome	Engineer	June 20, 1916	Lieut. 25th Reserve Bn.
J. A. Currie	Draughtsman	Aug. 1, 1916	Gunr. 73rd Field Battery
G. C. McIntosh	Draughtsman	Aug. 19, 1916	Pte. Div'l Cyclists
A. C. Wimberley	Draughtsman	Sept. 1, 1916	Gunr. 72nd Battery
R. J. Srigley	Hydro. Asst.	Oct. 1, 1916	Pte. 187th Battalion
R. J. McGuinness	Engineer	Nov. 15, 1916	Corp. 239th Battalion
A. E. Hughes	Packer	Nov. —, 1916	Pte. 211th Battalion
R. J. G. White	Chief Clerk	Dec. 1, 1916	Spr. Div'l Engineers
V. Meek	Engineer	Dec. 11, 1916	Lieut. Tunnelling Co.
T. M. Montague	Engineer	Dec. 11, 1916	Lieut. Tunnelling Co.
J. A. Telfer	Leveller	Jan. 1, 1917	Pte. Div'l Engineers
J. E. Caughey	Engineer	Mar. 1, 1917	Lieut. 78th Battery, C.F.A.
E. J. Switzer	Engineer	Mar. 12, 1917	Gunr. 38th Siege Battery
R. H. Waterhouse	Clerk	May 12, 1917	Pte. Can. Army Med. Corps
C. H. Giffen	Engineer	Sept. 10, 1917	Pte. C. A. S. C.
A. L. Tregillus	Engineer	Dec. 1, 1917	Lieut. Royal Flying Corps
W. S. J. Miller	Engineer	Dec. 10, 1917	Lieut. Royal Flying Corps
P. A. Fetterly	Engineer	Apr. 4, 1918	Lieut. Canadian Engineers
J. F. Block	Engineer	June 1, 1918	A.M.C. Royal Flying Corps
J. T. Danis	Clerk	— 1918	

* Died of wounds.
** Awarded D.S.O.

† Awarded Military Cross.
§ Died of sickness.

‡ Killed in action.

DEPARTMENT OF THE INTERIOR OF CANADA

Hon. ARTHUR MEIGHEN, Minister; W. W. CORY, Deputy Minister

Irrigation Branch---E. F. DRAKE, Superintendent

REPORT ON
IRRIGATION SURVEYS
AND INSPECTIONS

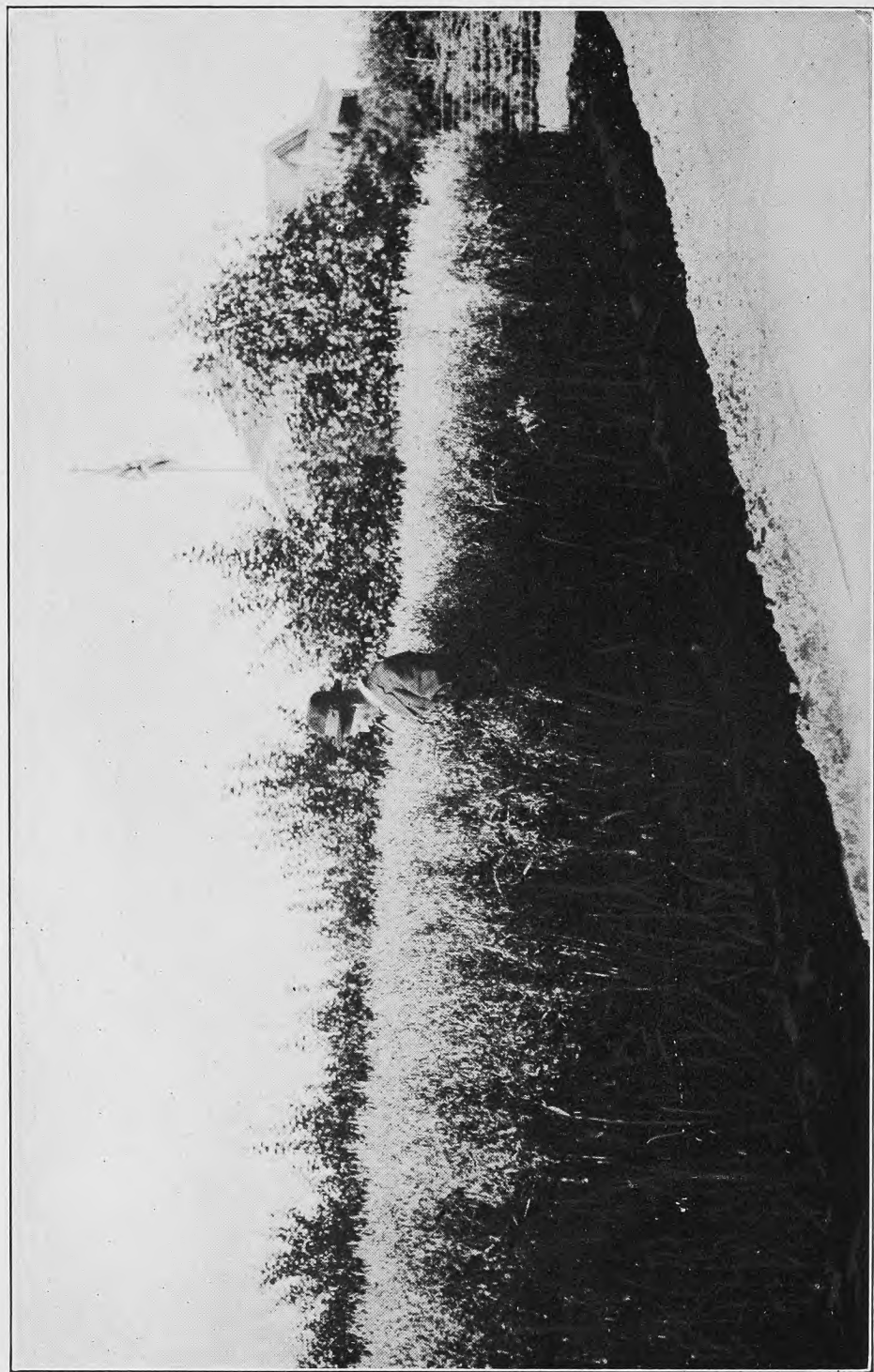
1917-18

OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

1919

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Oats on Alfalfa Soci. Irrigated. Yielded 101.7 bushels per acre. Strythmore, Alberta.

IRRIGATION

REPORT OF THE SUPERINTENDENT OF IRRIGATION.

E. F. DRAKE.

The past year has shown little development work in connection with irrigation. The high cost of labour and material has, naturally, discouraged construction work. The farmers have, generally, concentrated their efforts upon increased production of cereals, which are more easily and less expensively grown, and which require less labour than irrigated crops. The good yields for the past three years, coupled with the prevailing high prices, have amply justified this course.

A comparison of the acreage under cultivation for cereals in the years 1915 to 1917, inclusive, with the yield per acre and the price per bushel, is interesting. In Alberta the area sown to wheat increased in each of these years but the total yield decreased slightly for 1916 and considerably for 1917. In each case, however, the increased price more than compensated for the decreased yield. The 1917 crop of 18 bushels per acre, at an average price of \$1.74 per bushel, was even more profitable to the producers than the bumper crop of 1915, at 31 bushels per acre and 88 cents per bushel. The yield of wheat per acre decreased in close relation to the rainfall during the crop-producing season. Oats and barley showed a steady increase in area and value during this period, although the per acre yield in 1917 was about 25 per cent less than in 1916.

In Saskatchewan the area of wheat under cultivation increased slightly for 1916, but decreased appreciably for 1917, while the total yield decreased each year. Owing to the prevalence of rust in 1916, the total yield was so reduced that the total value also showed a decrease, but, with a still further decrease in yield in 1917, the value of the crop was a maximum for the three-year period. Oats and barley showed a steady increase in area and value, but the total yield of oats for 1917 showed a decrease.

The following tables are based upon the best obtainable information. The "normal prices" are estimated, and are, possibly, rather high, but precise information of average prices for past years is not readily obtainable:—

TABLE showing Yields of Wheat, Oats and Barley, in Alberta, for the years 1915, 1916 and 1917.

Crop and Year.	Yield per Acre.	Average Price per Bushel.	Average Price per Acre.		Yield per Acre.	Rainfall at Calgary, April to August.	
	Bush.	\$	\$	%	%	Inches.	%
<i>Wheat—</i>							
Normal	22.51	1.00 ²	22.50	100	100	11.56 ³	100
1915	31.12	.88	27.39	122	138	12.27	106
1916	24.99	1.33	33.24	148	111	8.93	77
1917	18.25	1.74	31.76	141	81	6.63	57
<i>Oats—</i>							
Normal	42.00 ¹	.34 ²	14.28	100	100		
1915	45.91	.31	14.23	100	109		
1916	48.11	.46	22.13	155	115		
1917	34.00	.63	21.42	150	81		
<i>Barley—</i>							
Normal	28.25 ¹	.50 ²	14.12	100	100		
1915	32.31	.44	14.22	101	114		
1916	29.04	.71	20.62	146	103		
1917	22.00	.98	21.56	153	78		

¹ Average for 10 years, 1908-1917.

² Estimated.

³ Average for 30 years, 1885-1914.

TABLE showing Yields of Wheat, Oats, and Barley, in Saskatchewan, for the years 1915, 1916 and 1917.

Crop and Year.	Yield per Acre.	Average Price per Bushel.	Average Price per Acre.		Yield per Acre.	Rainfall at Swift Current from April to August.	
	Bush.	\$	\$	%	%	Inches.	%
<i>Wheat—</i>							
Normal.....	18·50 ¹	1·00 ²	18·50	100	100	10·00 ³	100
1915.....	25·12	·91	22·86	124	136	10·14	101
1916.....	16·34	1·28	20·92	113	88 ⁴	14·09	141
1917.....	14·25	1·95	27·79	150	77	5·12	51
<i>Oats—</i>							
Normal.....	33·25 ¹	·34 ²	13·00	100	100		
1915.....	43·48	·32	13·91	107	114		
1916.....	43·06	·46	19·81	152	113		
1917.....	27·25	·62	16·90	130	71		
<i>Barley—</i>							
Normal.....	26·75 ¹	·50 ²	13·38	100	100		
1915.....	31·74	·46	14·06	109	119		
1916.....	27·00	·77	20·08	155	101		
1917.....	21·00	1·00	21·00	157	79		

¹Average for 10 years, 1908-1917.²Estimated.³Average for 30 years, 1885-1914.⁴Results affected by rust.

It is apparent from the reports received from our inspecting engineers, that irrigation development is not progressing satisfactorily in southern Alberta and southwestern Saskatchewan. A great deal of time and money has been spent in the construction of "irrigation works," that is, in canals and ditches for conveying water to the land. This money has not been wasted. Such works are necessary, as without them the land cannot be irrigated, but they alone are not sufficient to produce really beneficial results. It is undoubtedly true that few of the privately owned irrigation projects in these provinces are producing the results hoped for by their owners. There is much disappointment and even discouragement.

But it would be unfair to conclude, as some apparently have, that irrigation is therefore a failure. While in too many cases the results have been unsatisfactory, and in some cases even harmful, the causes are readily apparent and the remedy is available to those who are willing to apply it.

The average farmer who professes to practise irrigated farming really does nothing of the kind. He may *irrigate*, after a fashion; that is, he may at considerable expense build a ditch for the conveyance of water to his land, but *irrigated farming* means something more than merely turning water loose to flow at will over a tract of land, and that is practically all that has been done in very many cases. Usually little, if any, attempt is made to smooth the land. If the land is below the level of the supply ditch, if it seems to be fairly smooth and to have a reasonable slope, the usual practice is to turn the water out of the supply ditch at one or several points, and allow it to wander at will over the field. It is soon apparent, as the water spreads, that the surface which seemed so smooth is far from being so; it is usually a maze of shallow depressions, with intervening low knolls or ridges. Parts of such a field will receive no water, while other parts will receive so much that after a few years of this haphazard "system" of irrigation even the native grasses are drowned out and replaced by fox tail and other inferior grasses, and if there is alkali in the soil such over-irrigation brings it to the surface, with most injurious consequences.

Bringing the water to the land is but the first step in the art of irrigated farming; the other steps, without which no real success can be obtained, are:—

1. Thorough smoothing of the soil and preparation by means of dykes, borders, etc., for the control of water, so that all parts of the field may receive an even saturation;
2. Construction of drainage ditches to receive and carry off surplus water;
3. More frequent and less copious irrigations, where the conditions of water supply will permit.

But it is not always possible to practise irrigated farming as it should be done. Lack of capital, and the difficulty of obtaining labour when required, coupled with the necessity for producing as quickly and cheaply as possible the most readily saleable form of crop, account, in many cases, for the failure of settlers to utilize their irrigable land to the fullest advantage. It is unquestionably true, however, that in other cases the means have been available, but heedlessly, have not been applied. No excuse can be found for those who, having invested in a system of irrigation works, and having at their disposal capital and other means for making their investment profitable, neglect to take advantage of their opportunities.

The engineers of the Irrigation Branch have for several years, and notably for the past two years, been instructed to afford all possible advice and assistance to settlers regarding the proper methods of irrigating, the most desirable crops to grow, having regard to climatic and soil conditions, etc., and, generally, to place their services unreservedly at the disposal of all settlers. Some good has doubtless been accomplished in this way, but not as much as had been hoped for. Our officers are, primarily, engineers rather than agriculturists, and, while in the course of their duties they have acquired considerable knowledge of up-to-date agricultural methods, they cannot and do not, profess to be agricultural experts. We have found that settlers are generally willing to follow the advice of our inspecting officers in the design and construction of irrigation systems, and, to a limited extent, in the methods of applying water to the soil. When, however, our officers have attempted to give advice upon purely agricultural questions it has, as a rule, either not been very well received or ignored. Much of the stagnation in irrigation development is probably due to ignorance on the part of the settlers as to the proper methods to follow in order to produce the best results, and it would seem that the time is now ripe for a campaign of education along this line. Efforts are being made to secure competent agricultural experts who can first be taught the essential features of irrigation practice, and thereafter be assigned to the duty of advising and instructing the settlers. It is difficult, however, at this time to secure properly qualified men for this work, and there is very little prospect of much development along this line as long as the war continues.

Efforts are also being made to effect some system of co-operation between the engineers of the Irrigation Branch and the agricultural experts in the service of the Dominion and Provincial Departments of Agriculture, but here again the chief difficulty is the lack of competent men.

HYDROMETRIC SURVEYS (STREAM MEASUREMENTS).

The work of stream measurements has been continued as in former years. A few new stations have been established, while some of the older stations at which records have been obtained for several successive years have been abandoned. Generally, the policy has been to extend the work only where absolutely necessary, and to economize wherever possible by combining the work of stream measurement with that of irrigation inspections, so that one man may cover the territory formerly assigned to two.

During the open-water season, 169 gauging stations were maintained on streams and 7 stations on lakes; records were also obtained at 104 gauges on irrigation canals and ditches, while miscellaneous measurements were taken at 142 points on streams, ditches, and at springs. During the winter season, 102 regular stations were maintained.

The development of mining in northern Saskatchewan, and applications for power rights on Churchill river, directed attention to the lack of precise information of stream flow, particularly winter flow. An engineer of the Water Power Branch had taken some flow measurements during the summer of 1916, but these merely emphasized the necessity of securing fuller data covering the winter or low-water period, and this branch was asked to undertake the work.

Owing to the absence at "the front" of so many of our more experienced engineers, we had no one available who was qualified by past experience in sub-arctic travel to undertake the somewhat hazardous journey to this remote district in winter, and to remain there, practically alone, for the winter season. We were, however, fortunately able to secure the services of Mr. R. D. Fry, a well-qualified engineer with considerable experience in northern travel. Mr. Fry left Pas on the 22nd December, 1917, and returned to that point on the 5th April, 1918, the journey from Pas to Churchill river and return, being made by dog train. The records of stream flow secured by Mr. Fry are interesting and valuable, and will be published later in bulletin form. The manuscript records have, in the meantime, been placed at the disposal of the Water Power Branch.

Mr. Fry could, undoubtedly, have written a very readable and interesting report of his journey and of the incidents of life in the sub-arctic wilderness during the winter, but with characteristic modesty he confines himself to the briefest possible statement regarding the journey, and deals in his report only with the work which he was sent to do. His reference to the journey consists of the following laconic statement:—

"I left Pas Saturday, December 22, with two men and two dog trains, by way of Reeder, Rock, and Sturgeon-Namew lakes, arriving at Beaver Landing on December 24, where I commenced work at the outlet of Beaver Amisk lake. Then I proceeded north, metering Scooping rapids on the Sturgeon-weir river on my way, reaching the mouth of the Reindeer on January 12, where I made my headquarters camp during the winter's work."

INTERNATIONAL WATERWAYS TREATY.

(ST. MARY-MILK RIVER CASE.)

Article VI. of the treaty of January 11, 1909, between Great Britain and the United States, defines the manner in which the waters of the St. Mary and Milk rivers and their tributaries are to be measured and apportioned between Canada and the United States, under the direction of the International Joint Commission.

Public hearings of all the interested parties were held before the commission in May, 1915, and May, 1917, but no final decision has been given. In August, 1917, Mr. P. B. Mignault, one of the Canadian members of the commission, visited the West and accompanied by myself, went over the district involved; he examined the lands alleged to be irrigable and the works constructed or planned for the purpose of irrigating them.

The case was again taken under consideration by the commission in November, 1917, and at subsequent meetings and in the meantime, the officials of the United States Reclamation Service and Geological Survey and of the Irrigation Branch of

the Department of the Interior were authorized to study the stream flow data with a view to assisting the commission in reaching a decision upon the points in controversy.

On May 24, 1918, the commission issued an interim order, the purport of which is as follows:—

Before the beginning of the irrigation season of each year the proper officers of the United States and Canada shall, after conferring together, prepare a statement showing the total actual requirements of water for irrigation purposes of the United States and the Dominion of Canada, respectively, in the drainage basins of the St. Mary and Milk rivers during the irrigation season of that year, estimating the total amount of water required for each month of the season and the total acreage of land it is proposed to irrigate.

During the irrigation season the natural flow of the two streams shall be apportioned between the respective countries by their properly constituted reclamation and irrigation officers so as to satisfy in each month, so far as practicable, the actual requirements of each as set forth in the statement, or in any modifications thereof duly made.

The duty of measuring and apportioning the waters has been entrusted to Mr. Arthur P. Davis, Director and Chief Engineer of the United States Reclamation Service, and Mr. Edward F. Drake, Superintendent of Irrigation, Department of the Interior, Canada.

It is quite impossible to make any statement at this time as to whether or not this interim order will provide for a mutually satisfactory division of these waters even as a temporary measure, which it admittedly is. Much will depend upon the nature of the present season; if it should prove to be a "dry year," with the resultant decreased supply, and increased demand for water, difficulties may be expected; while, on the contrary, if there should be abundant rainfall, and the flow of the streams keeps up reasonably well, there will probably be enough water for all.

A number of international gauging stations have already been established by agreement between the Governments of the United States and Canada, and it is proposed to establish several more similar stations during the present year in order that the fullest possible information may be obtained regarding the quantity of water available and the use to which it is being put. The cost of installing these stations is shared equally between the two countries, as is also the cost of maintenance and of observations.

WATER SUPPLY INVESTIGATIONS.

The difficulty of obtaining water in portions of southern Alberta and Saskatchewan has been one of the drawbacks to the settlement of those districts, particularly along the lines of mixed farming. In the earlier days of settlement of the West certain districts assumed to be semi-arid were avoided by settlers, and enormous areas of this character were used only for ranching. But settlement gradually encroached upon these drier areas, small towns sprang up along the lines of railways, and each of these became the nucleus of, or distributing point for, a scattered farming community.

Given two or three years of fairly abundant rainfall, the farmers prospered, settlement increased, the villages and towns increased rapidly in size, and ranching gradually gave place to farming. But, unfortunately, dry years, or cycles of dry years, usually followed quickly, crops withered and failed from lack of moisture, the scanty sources of surface water supply dried up, and it became necessary to haul water in tanks or barrels for even domestic use. The small towns which had relied upon shallow wells, local streams or springs, found their supplies dried up or seriously depleted and were compelled to sink deeper wells or to go farther afield and pipe water from more distant sources at high cost. Successive dry years, with partial or complete crop

failure, resulted in the abandonment of many farms acquired under the homestead or pre-emption regulations, and in the general impoverishment of the settlers.

It is easier to recite the conditions obtaining in these semi-arid districts than to indicate the remedy. Improved methods of farming will help. Dry farming, or rather scientific farming methods, if properly applied and consistently followed, will doubtless make possible the growing of profitable crops in *alternate years* in regions where the annual rainfall is usually insufficient for profitable farming as it is practised in humid districts. Irrigation will also help where water can be brought to the land at reasonable cost and in sufficient quantity, and where the settlers will take the time and trouble to really master the art of crop production under this form of agriculture. One or the other of these, or both of them in combination, offer the best, if not the only, prospect of assured prosperity in regions of scanty rainfall.

But even though improved farming methods and the practice of irrigation may be generally adopted, the question of water supply remains unsolved. Living conditions cannot be regarded as satisfactory where the water supply is scanty or poor in quality, particularly where water for domestic use must be hauled for several miles. The question of domestic water supply has therefore naturally received a good deal of attention from the Dominion and Provincial Governments and at the hands of municipal and other organized bodies throughout the drier portions of the West.

Upon the initiative of the Lethbridge Board of Trade a "Water Conference" was held at Lethbridge, Alta., on June 22, 1917, which was attended by representatives of the Dominion and Provincial Governments and by many prominent persons who were interested in this problem or were likely to be able to assist in its solution.

The Dominion Government was urged to reserve land bordering on rivers, lakes, and other sources of water supply, to afford sanctuary for stock in times of drought and the co-operation of the Provincial Governments was asked in order that practicable road approaches might be provided giving access to these reserves.

The Dominion Government was also asked to arrange for the diversion of water from Milk river through the canals of the Alberta Railway and Irrigation Company, for the use of settlers along Etzikom coulée and in the vicinity of Pakowki lake.

Steps are being taken to examine the lands available for such reservation, and to determine whether or not they should be set apart for the purpose suggested. Fifty-two cancelled stock-watering reserves were inspected and reported upon by engineers of this branch during the season of 1917, and a considerable number of these, which otherwise would have been sold at public auction, have been reserved for water supply purposes. The remainder of the reserves, or as many of them as possible, will be inspected during the season of 1918.

Another phase of this question that is receiving attention at the hands of the engineers of the Irrigation Branch is the investigation of all sources of water supply, whether from streams, springs, or wells. Our engineers have been instructed to inquire carefully into this question in the course of their ordinary trips of inspection, and thus, without increasing our staff or noticeably adding to our expenditures, we have been able to accumulate a fund of valuable information which is being studied and tabulated and prepared for general use. Our engineers inspected 288 wells and 54 other sources of water supply during the season of 1917. This line of investigation will be continued throughout the current year.

Regarding the diversion of water from Milk river, through the Alberta Railway and Irrigation Company canals, by way of Stirling and Etzikom coulée and Pakowki lake, there are at present no facilities for diverting water from Milk river. The company built a canal several years ago, but the dam and headgates were subsequently destroyed by flood, the canal has been injured by slides in several sections, and, generally, the system is not in condition for use. It is believed, however, that it could be restored and made available for use at moderate cost, and there is some prospect of the company undertaking to restore this canal at an early date.

ALKALI INVESTIGATIONS.

In certain portions of the provinces of Alberta and Saskatchewan in which irrigation is practised, the presence of alkali has made it doubtful whether certain strongly impregnated soils were suitable for irrigated agriculture. In a few cases the surface indications were sufficient to permit of satisfactory conclusions being reached, but in the vast majority of cases chemical analyses are required, not only of the surface soil, but of the subsoil to a depth of four or five feet. A large number of samples has been collected by our field engineers and forwarded to Ottawa, where they have been tested in the chemical laboratory at the Central Experimental Farm.

Comparative specimens of soils from alkali and adjoining lands have also been secured in order to obtain data for establishing standard limits of tolerance. These samples have been tested and analysed and will form the basis for future work of a similar nature, affording very necessary information for determining the relative toxic effects of varying concentrations upon different crops in several localities. Other soils have been analysed in connection with specific undertakings, and several specimens of deteriorated concrete have been dealt with and passed upon by Dr. Shutt, Dominion Chemist, under whose direction this section of our work is carried on.

DRAINAGE.

There has been little development in connection with the reclamation of submerged or swamp lands by means of drainage. A few small projects have been authorized under the provisions of Section 1 of the Alberta Reclamation Act, and works are now being constructed. There are several similar applications now under consideration under Section 1 of the Saskatchewan Reclamation Act, but the construction of works has not as yet been authorized. No larger projects are as yet under construction, although in the province of Alberta two or three drainage districts are in course of formation. The high cost and scarcity of labour have not tended to encourage work of this character under present conditions. Instructions have been given for the inspection and survey of two proposed drainage projects of considerable size in the province of Saskatchewan but with our reduced staff of engineers it is doubtful if the work can be undertaken this year; it will be done if possible.

REPORT ON IRRIGATION AND CANADIAN IRRIGATION SURVEYS.

By F. H. PETERS, *Commissioner of Irrigation and Chief Engineer.*

In submitting this annual report attention is directed to the radical change in the form of submission that has been made. In an endeavour to condense the report as much as possible and submit only such matter as is necessary for record, all the subject-matter has been dealt with in one summary report. No original reports are submitted, but as a matter of record the names of all engineers in charge of any important part of the work have been mentioned. All efforts to prepare the report in an attractive manner have been sacrificed to the direct scheduling of the more important features of the work in brief form.

ORGANIZATION OF STAFF.

The organization of the staff was similar to that of last year with the proposed change carried into effect of combining the irrigation and hydrometric work in certain districts. All field survey development work having been discontinued, the staff, mainly in the field, but also in the office, has been correspondingly decreased in comparison with the years prior to 1917. Exclusive of summer assistants and other temporary employees, the number of persons employed on the staff was forty-seven; twenty-seven being employed in the office and twenty in the field.

OFFICE WORK.

Th office work carried out is indicated by the schedule below, which is given in a similar form to previous years for purposes of comparison.

Letters received.. . . .	10,658
Letters sent.. . . .	15,487
Applications for water rights recorded.. . . .	36
Plans examined and approved.. . . .	254
Plans amended.. . . .	164
Agreements, right of way, etc., recorded.. . . .	34
Right of way plans recorded in quadruplicate.. . . .	48
Water agreements filed or recorded.. . . .	599
Water agreements cancelled.. . . .	445
Water agreements transferred.. . . .	132
Notices for publication prepared.. . . .	20
Plans prepared.. . . .	233
Blue prints made.. . . .	12,368
Certificates issued under section 20.. . . .	43
Certificates issued under section 33.. . . .	34
Licenses recorded, in triplicate.. . . .	29
Weekly reports received from engineers.. . . .	1,418
Reports of discharge measurements received.. . . .	3,747
Reports of gauge heights received.. . . .	7,923
Descriptions of regular gauging stations, Form H 1.. . . .	41
Reports of changes at river stations, Form H 22.. . . .	155

STREAM ADMINISTRATION.

This very important work of transferring our records to the new system, which has been developed, was carried on actively throughout the year. One office engineer devoted all of his time to this work and considerable assistance was given by one other office engineer. The progress made on this work was again disappointing and it will take another year to get all the details completed. Nearly every stream has been dealt with and all the necessary data and information collected and arranged for future use. Great difficulties have been met with in this work because new complications have developed just as the work was developed and also in a great many cases the complete physical data necessary have been found lacking in one respect or another.

HYDROMETRIC SURVEYS.

The organization of the regular work was similar to that of previous years. The only change from last year was that in all the southern districts the duties of the irrigation inspecting engineer and district hydrometric engineer were combined. The territory was therefore divided into thirteen districts with an engineer in charge of each. In six of these one engineer did both irrigation inspections and hydrometric work; the remaining seven did hydrometric work only. The engineer in charge of the Calgary district also looked after the current-meter rating station.

During the open-water season, records were taken at 168 regular gauging stations on streams in Alberta and Saskatchewan, at 158 gauging stations on irrigation canals and ditches, and at 5 stations on lakes. Winter records were taken at 96 regular stations on streams during the past winter.

During the year 52 current-meters were rated. Two belonged to the Shawinigan Water and Power Company, 11 to the British Columbia Hydrometric Survey, 5 to the Manitoba Hydrometric Survey, 2 to the Canadian Pacific Railway Company, 2 to the Ontario Hydro-electric Power Commission, and the balance, 30, belong to this branch.

The assignment of the office staff was nearly the same as last year but the efficiency of the staff was somewhat impaired by changes in the personnel.

Last December an engineer was sent in from Pas, Manitoba, to the power sections of the Sturgeon-weir and Churchill rivers near the Manitoba-Saskatchewan boundary, to obtain records of the winter flow. The result of his observations will have a considerable bearing on the development of hydro-electric power in that locality, and will, therefore, be of considerable interest. His reports, however, will not be received in time to be included in this year's report.

FIELD WORK.

The field work, necessary for administration, was carried on in much the same manner as last year, but a few changes which affected the work to a considerable extent are being noted.

Over a considerable area of the drier parts of Alberta and Saskatchewan, the question of water supply for domestic, municipal, and industrial purposes, is one of prime importance. It may be said, without any fear of contradiction or the slightest exaggeration, that in certain districts the agricultural and community development is absolutely dependent upon the development of a sufficient supply of water. There is nothing new about this fact, but like many other essential facts it is often overlooked or forgotten. Thanks largely to the farsightedness and activity of the Lethbridge Board of Trade, this feature, as outlined above, was prominently brought forward in the fall of 1916 and in February of 1917, and the question was taken up by the Scientific and Industrial Research Commission at Ottawa.

As a direct result of the information given to the commission, concerning the work being done along these lines, by the Geological Survey and the Irrigation Branch, it was arranged that our inspecting engineers would collect all the data possible in their respective districts, concerning domestic water supplies and wells. The information was to be collected to indicate the surface supply that is now available and in connection with the deeper wells special attention was to be given to getting a log of the well so that this special information dealing with the underground geological conditions, could be supplied to the Geological Survey for their information in determining the possibilities of underground sources of water supply.

Another outcome of the activities of the Lethbridge Board of Trade, was the arrangement to cause inspection by our engineers of all stock-watering reserves, which have not yet been alienated from the Crown. This with a view to maintaining with the Crown all the remaining water reserves that in future may be valuable in connection with the increased raising of stock by the prairie farmers. These water reserves were very wisely set aside in the old days of the ranching industry and when this gave place to the development of farming, it had apparently been assumed, without considered thought, that the usefulness of the water reserves was past.

A considerable amount of work was done during the season by inspecting engineers in making the inspections in connection with the matters referred to above. All the data collected were submitted on suitable forms, which have been filed away for ready reference and use in the future.

As we now have hydrometric records over a fairly long period and as the major portion of the construction work on the smaller irrigation projects has been completed, it was planned this year, in an endeavour to increase the economy and efficiency of the work, to combine irrigation and hydrometric work in certain districts.

This was done in the Cypress Hills country, which was divided up into four districts, and also in the case of the Calgary district. The engineer in each district had one assistant.

Cypress Hills District North.—This district was handled by Mr. J. S. Tempest, who took the field on March 19, and finished his field work on November 22 (September 22 to November 10 was put in on other work). The season's work comprised 176 actual working days. Eighty-three inspections and seven surveys were made. Seventy-five gaugings were made and four new gauging stations established. Data were gathered concerning 46 wells and 20 domestic water supplies. The number of miles travelled by train was 3,057 and by other means, principally team and democrat, 2,219. These figures include the work done on the special measurement of early spring run-off.

Mr. Tempest reports in an interesting manner upon the general status of irrigation in his district as follows:—

IRRIGATION IN CYPRESS HILLS DISTRICT NORTH.

Irrigation does not appear to have been so extensively practised in the district as in former years. This was not due, as a rule, to any lessened interest or faith in irrigation but rather to a peculiar combination of circumstances. Labour was expensive and difficult to secure. The beginning of 1917 seemed to give promise of another season of abundant moisture like the two preceding seasons of 1915 and 1916 when the need of irrigation was not very pronounced. There was apparently sufficient moisture in the ground to serve the needs of the growing crops until the time of the usual June rains, so the available labour was put to what was considered more necessary work than that of irrigation. Then again there had been two years of exceptional success in growing grain throughout the dry belt. Grain growers with the high price of wheat were getting rich, and there was a general movement amongst farmers and ranchers alike to put all the labour and land possible into growing grain. When the usual June rains did not come and the hay meadows were beginning to suffer for want of moisture, the creeks were mostly dry and the chance to irrigate had passed. Many of the owners of irrigation schemes admit that they made a mistake in delaying irrigation, being deceived by the early promises of the season. The only safe and sure way is to keep irrigation works in good order and in readiness all the time to put into use whenever the land can be benefited by the application of water.

The bulk of the irrigation schemes in the district are devoted to the growth of wild grass. As a rule very little effort has been made to apply the water evenly over the ground, with the result that while some areas are being ruined by water-logging, others are left high and dry and suffering for want of water. It appears that the flat lands irrigated by the check system have commonly been watered so lavishly that the more valuable grasses have been drowned out and supplanted by coarse slough grasses and plants. In many places water-logging and the rise of alkali has caused a serious deterioration in the value of the land. This is very notably the case in the lower Maple Creek valley where hundreds of acres of land that formerly produced excellent crops of blue joint under irrigation have been watered with such prodigality that now they are either being abandoned on account of alkali and a water-logged condition or they are producing crops of coarse slough grasses, fox tail, cat tails and semi-aquatic plants. An effort should be made to reclaim such places and to adopt some plan of drainage that will be acceptable to those interested. There are other places similarly affected, though perhaps not to so large an extent, in the Piapot, Hay and McKay Creek valleys, all calling for attention in the matter of drainage and the more careful application of water.

Good work has been done in the past in the construction of efficient works for diverting the available water for irrigation purposes, but it still remains for the owners to make the best use of the water. The old haphazard method of diverting water from the creeks into the irrigation-ditches and then opening up a few breaches in the banks and allowing the water to run where it will, and sometimes as long as it will, is still too much in vogue. The patient directing and controlling that is required to apply the water evenly to prevent flooding of some parts and neglect of others, savours, as a rule, too much of farming to suit the professional rancher. There is evidence, however, of an awakening interest in more intensive methods of cultivation under irrigation in some quarters. Messrs. Stark & Burton, near Medicine Hat, who have grown alfalfa under irrigation for a number of years with great success, have recently gone to the expense of having a large tract of land laid out on the border system and sown to alfalfa. The scheme has proved a great success. Nearly three tons of alfalfa to the acre were produced this year with only one flooding; there was no water available after the first cutting. Probably encouraged by the success of the above scheme as well as by a careful study of the subject of raising a maximum amount of feed in the most economical manner, Mr. James Mitchell, of Medicine Hat, is planning to lay out about 140 acres on the border system of irrigation and sowing to alfalfa. Mr. Mitchell will pump water from the Saskatchewan river using natural gas for fuel.

There is some indication that irrigation is approaching the transition stage from the old method of raising about a ton per acre of wild hay to the more modern methods of producing from two to four tons of tame grasses and alfalfa. The apathy and even discouragement that is evident in some quarters regarding irrigation is merely an indication that the old methods are beginning to lose ground in the general advancement of agriculture, and the minds of many owners are open to suggestions for improvement. They only require to be shown that any new investments will be profitable.

It seems to me that it would be a wise plan to engage a few thoroughly experienced and practical irrigation farmers to work with the owners of the irrigation schemes to demonstrate on their own farms how best to apply the water to meet the peculiar needs of the scheme, when to apply the water and when to stop, how to direct it over the ground and how to avoid damage from waterlogging and rise of alkali, how to lay out border systems, and the hundred and one little details in manipulating to best advantage an irrigation project. Irrigation is still very much in its infancy in the district and there are few thoroughly capable and practical irrigators to follow as examples. With the exception of the accommodation for the disposal of waste water the schemes of the district are as a rule quite complete as far as the work of the irrigation engineer is concerned, but there is much for the practical irrigation farmer to do before the different projects can be worked to advantage and made to realize the big profits they should.

Cypress Hills District South.—This district was handled by Mr. H. W. Rowley, who took the field on March 17 and completed his field work on December 1. The season's work comprised 233 working days. Forty-four inspections, two surveys and 118 gaugings were made. Data were gathered concerning 12 wells. The number of miles travelled by train was 151 and by other means 3,318, principally by team and democrat. These figures include the work done on the special measurement of early spring run-off.

Cypress Hills District East.—This district was handled by Mr. M. H. French, who took the field on March 19 and finished his field work on November 1 (October 1 to 16 was spent in the office at Calgary). The season's work comprised 182 actual

working days. Ninety-two inspections and six surveys were made. One hundred and fifteen gaugings were made and one automatic gauge station was constructed, which required eleven days' work. Data were gathered concerning ninety-six wells and one domestic water supply. The number of miles travelled by train was 3,121 and by other means, principally team and democrat, 2,346. These figures include the work done on the special measurement of early spring run-off.

Mr. French reports on the general status of irrigation in his district, as follows:—

IRRIGATION IN CYPRESS HILLS DISTRICT EAST.

The development of the irrigation schemes has consisted mainly in the construction of the main diversion works; leaving the field laterals and drainage ditches for some later time. This early development has been rapid and many thousands of acres have been rendered irrigable and possible of greater productivity. This increased productivity, however, is more of a latent value reserved for the future, since little or no water is being applied to a large part of these lands. The putting of the irrigable lands into condition to achieve maximum results has not been carried out to the extent desired. In fact, unless one considers certain conditions hereafter mentioned, he might not entertain a very optimistic view of the part to be played by irrigation in the agricultural development of the Cypress Hills district. The fact that irrigation is not being practised as extensively and scientifically as at first is not a valid reason for the impression that it is of no value to the country. We erred in that we expected too much. The West abounded in the most sanguine optimism, and irrigation likewise received its share of enthusiasm. Here was the "Aladdin's Lamp," by which the agriculturist might realize maximum yields, but when the results did not come up to expectations, opinions swerved towards the other extreme.

It is true that grain is being grown profitably without irrigation, and will be so grown for many years, but the time is coming when the gradual depletion of the fertility of the soil by continuous "grain mining" will increase the expense and difficulty of growing such grain with profit. The lighter the soil the sooner will this difficulty occur, while the heavier soils apparently can be "grain-mined" with impunity for several decades, as for instance, the heavier soils near Regina and Indian Head. In future years, they, whose fathers laughed at the benefits to be received from irrigation, will gaze with envious eyes upon the irrigated lands of the West, which are being maintained to their fullest degree of fertility and productivity, by scientific methods of irrigation farming. We must take a broader outlook, and see in the future the time when irrigation will surely come into its own, and be valued more according to its merits.

Regarding the accomplishment of any improvement in the irrigation methods of the district, all endeavours in that direction were productive of very little immediate results. These missionary efforts may bear fruit in the future—as no doubt they will—when the labour situation improves. There can be no gainsaying the fact that the constant reiteration of what constitutes good irrigation practice will result in better methods of applying the water and more interest being taken in irrigation. The principal need to-day is expert agricultural advice rather than that of the engineer. Whether this is given by means of government demonstration farms or by privately owned plots under government supervision is really immaterial. The main thing is to get something started along these lines, although I have always considered the personal farm to farm services of the irrigation inspector or agricultural demonstrator productive of excellent results. Extensive and systematic study of agri-

culture is invaluable and necessary for the discovery of better methods of farming, but it must be remembered also that every intelligent farmer is largely an experimenter and observer of crop conditions, whose discoveries are disseminated chiefly by word of mouth from farmer to farmer unless collected by interested parties and distributed to the world in pamphlets and government reports. Many a farmer is doing good work along these lines.

Cypress Hills District West.—This district was handled by Mr. J. C. Milligan, who took the field on March 15 and finished his field work on November 11 (October 9 to November 5 was spent in the Calgary office). The season's work comprised 186 actual working days. Eighty-nine inspections and four surveys were made. One hundred and ninety-four gaugings were made. Data were gathered concerning forty-eight wells and two domestic water supplies. The number of miles travelled by train was 952 and by other means, mainly team and democrat, 3,272. These figures include the work done on the special measurement of early spring run-off.

Mr. Milligan has submitted a very interesting report on the ranching industry, from which the following extract is quoted:—

RANCHING INDUSTRY.

As my work in the Department has, during the last few years, been closely allied with the ranching industry, I have thought in making my annual report that a few observations dealing with the subject and with special reference to the growth of feed for the upkeep of the beef herds should be incorporated.

Ranching has gone through a great transition period in the last few years since the day of the old open range method, when practically unlimited range was at the disposal of every rancher, herds of cattle could be moved to suitable pastures as occasion demanded and drought and poor feed were practically non-existent. The only dangers which had to be encountered were severe blizzards and long continued snowfalls, which were not of frequent occurrence. Now, the range is restricted to specified parcels of land closely fenced, where conditions of feed, water and shelter are such that a clearly defined policy requires to be adopted, combining as its essentials, systematic training and technical knowledge.

The old time cattle man, whose methods, suitable for the time and conditions were based on the principle of small profits on a large turnover, is gradually being replaced by the more up-to-date feeder, whose object is to make large profits on a smaller turnover, or in other words, to practise intensive ranching. This result can only be obtained by increased vigilance in the breeding, care and especially the feed of cattle. There can be no question but that great attention is being paid to the breeding of cattle, as is evident by the ever increasing importance of the various sales of pedigreed cattle which take place periodically in the West. The evidence, however, that the feeding of cattle has not yet been solved, is brought to light by the depletion of herds and the large export business in young stock and cows. Last year, 1916, when weather conditions were favourable, large imports of cattle were made, while during the present season, which is not nearly so good, a large part of this increase was exported. This was probably due to two different reasons: the increased market demand by the canners for this grade of stock, but principally, the lack of sufficient feed.

This great loss of breeding and beefing stock can only be considered a disaster from which certain parts of the country will not speedily recover. A large decrease of this class of stock was noticed in West Cypress Hills district but there is no question that other ranching districts also suffered.

This condition could easily have been overcome if more attention had been given to the cultivation of suitable land and the use of irrigation as far as possible. Most parts of the western provinces do not suffer as a general rule,

even in a dry summer, from the lack of summer range or feed, but from winter and early spring feed. The solution of the problem appears to be simple, and is so, if only ranchers will take the necessary steps. The growing of feed must be seriously considered and if it is found impossible to grow hay or feed and no irrigation is obtainable, then summerfallow should be adopted and green feed produced. The elimination, or at least the alleviation, of that dangerous factor of drought with its attendant, scarcity of feed, must be sought after. This, as far as cereal crops are concerned, is being dealt with under conditions of planting, cultivation and selection of drought resisting seeds, then surely it is important that the question of supplying feed for the preservation of our beef herds should be as thoroughly gone into. A certain amount of attention is being devoted to this subject but the rancher proper has not yet been interested.

Under the old system of ranching, a wastage of as high as 10 per cent could be borne with profitable results. Cattle usually wintered poorly and great shrinkage had to be made up by the early growth of grass. Winter feeding gradually was adopted till at present the wastage has been considerably cut, but not eliminated. Shrinkage, however, takes place and a great loss of time occurs in bringing cattle to marketing conditions.

Present conditions still too nearly approximate the old system of ranching. Large areas are leased and only small areas are available for the raising of feed. Cattle are therefore required to pasture winter and summer and only if they reach an exhausted condition are they fed. It is quite common to have areas of 10,000 acres of leasehold and only 160 acres of freehold; it can thus easily be seen that proper feeding is not resorted to. Now that greater and quicker production is required investigations should be made to study these conditions and if possible rectify them. Quicker production can be made by a study of the winter-feeding possibilities and greater production can be achieved by a study affecting the re-arrangement of pasture land and cultivated land.

Feed has always been a much discussed question, and at present two much energy is being expended on the discussion of the best kinds of feed for cattle. The whole question hinges, not on the best kind of feed so much as the kind of feed which can be best grown on the land available, in other words, the economic crop with regard to soil, natural conditions and climate. As an example, alfalfa—a splendid feed—has been advertised greatly and glowing accounts have been issued regarding its feeding value. On account of this extensive advertisement many trials were made to grow this crop without sufficient thought being given to conditions of soil, subsoil, etc. and nearly all these trials were failures. Alfalfa can be grown in the West successfully but conditions must be suitable. If conditions are not suitable, time and money are wasted and production lowered.

To eliminate this waste and to accelerate production some system should be evolved which would narrow the limits of failure.

So much has been written and so many experiments have been made that it would be superfluous on my part to make any extensive comment on the subject of winter feeding. There seems to be no doubt that even with the high price of labour and feed, the system is profitable without taking into consideration the quicker finishing and hence greater production of stock. With judicious and economical winter feeding, stock can be brought to as high a state of perfection in two years as can be done with all pasture method in three to four years, thus saving at least one-third of the time in production and making the carrying power of the ranch one-third greater. It would probably be advisable to use at present an all-forage and root feed in preference to grain feed as grain is in such great demand for food purposes.

In order to have efficiency and great production, ranches must be better balanced than at present with respect to summer and winter feed conditions. Pasture lands must necessarily be land which cannot possibly be cultivated

otherwise economy is not being practised, as it is a well known fact that cultivated land will support, at the very lowest estimate, 100 per cent more cattle than uncultivated land. An economic factor must be established for each ranch, giving the proportion of cultivated land necessary for the winter support of cattle carried on the pasture land during the summer months. The pasture land would support a certain number of cattle for seven or eight months during the summer, and the cultivated land provided, would be required to produce proportionately the same amount of flesh-forming food which this pasture affords during the summer months, so that a mean monthly increase in weight, per head, would be made. If this method were adopted it would ensure that the full economic possibilities of ranching land was reached and would result in greater and quicker production of beef cattle.

This economic factor would vary according to the situation of the land, climatic conditions, and whether irrigated or non-irrigated land was used in the production of feed. An easy determination of this economic factor could be made in the case of irrigated land as with efficient irrigation constant production is assured, the only matter requiring consideration being the determination of the most economic crop which, in most cases, would not be a difficult matter. It is under conditions of this description where feed is grown that irrigation obtains its full economic value in this country. In non-irrigable areas the difficulties in determining the economical factor would be greater on account of drought. Dry farming methods would require to be closely followed and as far as possible areas for production picked out so that shelter from southwest winds would be obtained. It would also be necessary to allow a factor of safety, or rather to crop a larger area of land than ordinarily necessary so that enough production would be assured. Surplus crop could be used in making an extra finish on beef cattle or stored for use during the following winter and would not be wasted. If light crops were obtained, winter feeding would require to be proportionately light and little increase of weight on the cattle would be obtained, but no unnecessary sacrifice of stock would be called for.

It can easily be seen that if some method is adopted, as outlined above, market conditions will be made more stable and the usual annual fall glut of the market eliminated.

There seems to be no question that an inquiry should be held into ranching conditions in the West and that in this connection some co-operation is required between the Live Stock, Agricultural and Irrigation Departments of the Dominion Government, in dealing with the question. The ranching industry seems to be poorly organized and there is no doubt that the time has arrived when this condition should be improved.

At present the only help a rancher or farmer receives from the irrigation inspector is practical advice regarding the distribution of water and maintenance of his irrigation system. This is important as far as it goes, but what would be of greater value at this stage of progress is advice from an agricultural irrigation expert, who would be able to persuade the rancher to make an economic use of his irrigated land and give him the necessary advice regarding crops and cultivation. Very little irrigated land has been broken up and a great deal of energy is at present being spent in irrigating grasses, which produce a certain amount of feed yet are not economic possibilities. Little attention is given when an irrigation inspector tries to give advice about the growing of crops, as the rancher knows that the inspector's real business is engineering and considers any advice on agricultural matters proffered as of little value. If, however, an agricultural expert were available there is no question but that he would be able to hold their attention and his advice would be followed.

Out of a total of about 90,000 acres of privately-owned irrigable land in Alberta and Saskatchewan only some 20,000 acres are being usefully cultivated, the balance of 70,000 acres being used only for grazing. This condition in itself shows that the necessity for action is real. Some sort of popular advertisement should be devised to bring before each individual rancher his duty to the country and try and induce him to greater efforts for a larger production of stock. This policy is being adopted successfully in connection with the raising of hogs and grain. As I have mentioned before there is no question of the efficiency of irrigation or the raising of feed. It is no controversial question and it can be advocated without fear of contradiction but it requires more popular advertisement than has been given to it in the past. The Department should be willing to give, along with its advice on irrigation, expert agricultural advice. These two go hand in hand and I doubt if any improvement can be hoped for till this is done.

Macleod District.—This district was operated as a combination one and the irrigation work comprised practically all of the old Calgary irrigation district. Mr. S. H. Frame had charge of the work in this district and used a Ford car instead of a team and democrat. This new method of transportation proved to be a great advantage over the old. Mr. Frame took the field on March 3 and finished his combined work in the field on November 1. The season's work comprised 220 working days. The total number of inspections made was 86 and 2 surveys were made. Data were gathered concerning 51 wells and 21 domestic water supplies. Four hundred and eight gaugings were made. The number of miles travelled by train was 1,911 and by other means, mainly motor car, 5,984.

SPECIAL INSPECTIONS—DOMESTIC, MUNICIPAL, IRRIGATION AND INDUSTRIAL.

This work was carried on under the immediate supervision of Mr. W. E. G. Hall, the office engineer, who supervised the work of all inspecting engineers and particularly in respect to the two special inspectors, and saw that for each trip the inspections were properly grouped, as regards economy in time, travel, expense and the urgency of an early report. The office engineer examined and checked 254 plans of all descriptions and 23 descriptions for right of way.

Mr. C. Chambers carried out the special inspections in Alberta, totalling 53 in number, and made 9 surveys of all descriptions. He travelled 6,592 miles by train and 1,624 miles by team and other means. It is to be noted that there were no inspections required for municipal purposes this year; that there were only half the number of inspections of industrial schemes and nearly double the number of inspections of drainage schemes for reclamation purposes this year, as compared with last.

Mr. E. L. Miles carried out the special inspections in Saskatchewan, totalling 64 in number, and made 6 surveys of all descriptions. He travelled 10,110 miles by train and 2,080 miles by motor car or other means. The number of inspections of domestic schemes were less than half this year, as compared with last, but the remainder of the work was about the same.

MUNICIPAL WATER CONSUMPTION DATA.

The collection and compilation of municipal water consumption data was inaugurated towards the end of the year 1914, and in the year 1915 we received information complete for the year from fifteen cities and towns in Alberta and Saskatchewan. In the following year we received records for the whole year from the same cities and towns.

During the year 1916 an endeavour was made to obtain this data from a greater number of places, with the result that for the year 1917 we have received complete records for the year from twenty-one cities and towns in Alberta and Saskatchewan.

These records have been compiled in a manner similar to former years and are submitted hereunder.

Daily Record of Water Consumption in Imperial Gallons.

1917. — Month.	Regina. Population, 35,000.						Saskatoon. Population, 25,000.						Moosejaw. Population, 17,000.						Prince Albert. Population, 6,500.					
	Per Head for Domestic purposes.						Per Head for Domestic purposes.						Per Head for Domestic purposes.						Per Head for Domestic purposes.					
	Daily Average for the Month.	Per Head for Industrial purposes.	Per Head for other purposes.	Per Head for all purposes.	Unaccounted for.		Daily Average for the Month.	Per Head for Industrial purposes.	Per Head for other purposes.	Per Head for all purposes.	Unaccounted for.		Daily Average for the Month.	Per Head for Industrial purposes.	Per Head for other purposes.	Per Head for all purposes.	Unaccounted for.		Daily Average for the Month.	Per Head for Industrial purposes.	Per Head for other purposes.	Per Head for all purposes.	Unaccounted for.	
January.....	2,537,515	59.6	12.9	72.5	1,341,480		1,341,480	22.5	16.4	7.2	61.0	14.9	998,000	49.9	8.8	58.7	58.7		531,623	81.8	81.8	81.8	81.8	
February.....	2,475,615	56.7	14.0	70.7	1,335,785		1,335,785	22.5	16.4	7.2	61.0	14.9	1,096,000	56.3	8.2	64.5	64.5		586,764	90.3	90.3	90.3	90.3	
March.....	2,593,242	58.3	15.8	74.1	1,892,959		1,892,959	22.5	16.4	7.2	61.0	14.9	1,036,000	55.2	5.8	61.0	61.0		554,697	85.3	85.3	85.3	85.3	
April.....	2,470,217	61.6	9.0	70.6	1,885,400		1,885,400	22.5	16.4	7.2	61.0	14.9	852,000	41.1	9.0	50.1	50.1		525,600	80.9	80.9	80.9	80.9	
May.....	2,301,374	57.9	7.0	64.9	1,579,903		1,579,903	22.5	16.4	7.2	61.0	14.9	1,107,000	54.8	10.3	65.1	65.1		542,019	83.4	83.4	83.4	83.4	
June.....	2,390,768	57.0	11.1	68.1	1,713,500		1,713,500	24.1	15.1	8.6	67.2	19.4	1,143,000	52.6	14.6	67.2	67.2		541,528	83.3	83.3	83.3	83.3	
July.....	2,469,816	61.0	9.3	70.3	1,960,451		1,960,451	24.1	15.1	8.6	67.2	19.4	991,000	44.3	14.0	58.3	58.3		615,406	94.7	94.7	94.7	94.7	
August.....	2,521,576	59.5	12.1	71.6	1,802,548		1,802,548	26.1	14.3	6.8	72.0	24.8	850,000	27.1	19.9	60.0	60.0		536,710	82.6	82.6	82.6	82.6	
September.....	2,512,878	56.3	15.0	71.3	1,625,100		1,625,100	26.1	14.3	6.8	72.0	24.8	1,078,000	43.5	12.6	55.1	55.1		515,517	79.3	79.3	79.3	79.3	
October.....	2,690,480	58.5	17.5	76.0	1,633,322		1,633,322	24.5	16.7	0.7	65.3	23.4	937,000	42.5	17.6	56.7	56.7		518,391	79.9	79.9	79.9	79.9	
November.....	2,531,431	59.7	12.3	72.0	1,593,366		1,593,366	24.5	16.7	0.7	65.3	23.4	964,000	39.1	14.2	56.7	56.7		513,667	79.0	79.0	79.0	79.0	
December.....	2,796,217	64.8	15.0	79.8	1,669,677		1,669,677	24.5	16.7	0.7	65.3	23.4	967,000	42.7	17.6	56.7	56.7		574,087	88.3	88.3	88.3	88.3	
Average for the year.....	2,524,261	59.2	12.6	72.1	1,668,624		1,668,624	24.4	15.6	5.8	66.4	20.6	1,001,533	45.8	13.1	58.9	58.9		546,419	84.1	84.1	84.1	84.1	

CITIES AND TOWNS IN THE PROVINCE OF SASKATCHEWAN.
Daily Record of Water Consumption in Imperial Gallons.

1917. Month.	North Battleford. Population 4,000.						Scott. Population 350.						Weyburn. Population 3,100.						Estevan. Population 700.					
	Per Head for Domestic Purposes.						Per Head for Domestic Purposes.						Per Head for Domestic Purposes.						Per Head for Domestic Purposes.					
	Daily Average for the Month.	Per Head for Industrial Purposes.	Per Head for Other Purposes.	Per Head for All Purposes.	Unaccounted for.		Daily Average for the Month.	Per Head for Industrial Purposes.	Per Head for Other Purposes.	Per Head for All Purposes.	Unaccounted for.		Daily Average for the Month.	Per Head for Industrial Purposes.	Per Head for Other Purposes.	Per Head for All Purposes.	Unaccounted for.		Daily Average for the Month.	Per Head for Industrial Purposes.	Per Head for Other Purposes.	Per Head for All Purposes.	Unaccounted for.	
January	81,832	12.8	2.0	2.3	20.9	3.4	12,194	8.9	25.9	34.8	...	77,117	24.9	...	...	...	24.9	...	30,065	22.0	18.4	2.5	42.9	...
February	95,716	13.9	1.8	3.8	23.9	4.3	16,607	10.9	36.5	47.4	...	84,888	27.4	...	...	...	27.4	...	35,321	30.0	17.9	2.5	50.4	...
March	120,332	10.9	1.6	6.8	30.1	10.8	17,032	15.2	33.5	48.7	...	108,226	34.9	...	...	...	34.9	...	55,096	55.7	20.7	2.3	78.7	...
April	102,044	9.8	1.5	5.1	25.5	9.1	15,517	13.3	31.0	44.3	...	110,875	35.8	...	...	...	35.8	...	37,500	29.8	21.4	2.4	53.6	...
May	82,393	10.1	1.7	2.3	20.6	6.5	15,806	15.7	29.5	45.2	...	112,399	36.2	...	...	...	36.2	...	47,193	44.4	20.7	2.3	67.4	...
June	99,234	8.8	1.4	7.1	24.8	7.5	14,733	15.2	26.9	42.1	...	111,120	35.8	...	...	...	35.8	...	50,633	34.2	35.7	2.4	72.3	...
July	92,122	8.6	1.3	3.8	23.0	9.3	15,484	13.0	31.2	44.2	...	111,816	36.1	...	...	...	36.1	...	52,193	23.8	27.7	2.3	74.5	...
August	73,730	9.3	1.8	3.7	18.4	3.6	9,194	4.6	21.6	26.2	...	91,097	29.4	...	...	...	29.4	...	49,032	19.3	27.7	2.3	70.0	...
September	71,161	9.6	1.9	3.8	17.8	2.5	4,933	8.4	5.7	14.1	...	81,472	26.3	...	...	...	26.3	...	38,533	21.8	2.3	23.8	47.9	...
October	83,102	9.6	2.1	3.8	20.8	5.8	2,539	7.2	...	7.2	...	82,359	26.6	...	...	...	26.6	...	33,290	22.3	2.2	23.0	47.5	...
November	87,674	8.6	1.7	3.8	21.9	7.8	32,233	8.3	83.8	92.1	...	73,458	23.7	...	...	...	23.7	...	31,333	18.7	2.3	23.8	44.8	...
December	119,325	9.8	7.8	1.9	29.8	10.3	31,387	7.1	81.9	89.6	...	75,997	24.5	...	...	...	24.5	...	36,387	26.8	2.2	23.0	52.0	...
Average for the year	92,389	10.2	2.2	4.0	23.1	6.7	15,638	10.7	34.0	44.7	...	93,402	30.1	...	...	...	30.1	...	40,965	29.1	16.6	12.8	58.5	...

1917. Month.	Battleford Population 1,500.						Humboldt. Population 1,450.						Sutherland. Population 940.						Kindersley. Population 1,000.					
	Population 1,500.						Population 1,450.						Population 940.						Population 1,000.					
	Daily Average for the Month.	Per Head for domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for domestic Purposes.	Per Head for Human Consumption.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.
January.....	28,839	19.2				19.2	16,939	10.0	1.7		11.7		1,324	1.4					45,372	4.9	40.5			
February.....	47,004	31.3				31.3	17,400	10.3	1.7		12.0		242	0.3					46,200	5.0	41.2			
March.....	37,868	25.2				25.2	30,884	19.6	1.7		21.3		403	0.4					47,967	5.9	42.1			
April.....	37,600	25.1				25.1	31,517	20.0	1.7		21.7		775	0.8					47,526	6.1	41.4			
May.....	24,581	16.4				16.4	34,529	22.1	1.7		23.8		750	0.8					48,172	5.1	43.1			
June.....	46,470	31.0				31.0	26,283	16.4	1.7		18.1		1,723	1.8					40,828	6.2	34.6			
July.....	46,451	31.0				31.0	57,042	37.6	1.7		39.3		1,667	1.8					60,996	6.0	55.0			
August.....	9,032	6.0				6.0	31,948	20.8	1.7		22.0		1,686	1.8					39,020	6.0	33.0			
September.....	8,667	5.8				5.8	34,033	21.8	1.7		23.5		2,195	2.3					53,743	6.2	47.5			
October.....	7,742	5.2				5.2	39,884	19.6	1.7		21.3		2,762	2.8					50,727	5.9	44.8			
November.....	8,000	5.3				5.3	34,533	22.1	1.7		23.8		2,762	2.8					69,886	6.0	63.4			
December.....	8,942	6.0				6.0	27,823	17.5	1.7		19.2		3,335	3.5					52,856	6.6	46.3			
Average for the year.....	25,933	17.3				17.3	31,151	19.8	1.7		21.5		1,635	1.7					50,233	5.8	44.4			

CITIES AND TOWNS IN THE PROVINCE OF ALBERTA.

Daily Record of Water Consumption in Imperial Gallons.

1917. Month.	Edmonton. Population 53,800.						Lethbridge. Population 10,000.						Medicine Hat. Population 9,360.						Redcliff. Population 2,200.					
	Population 53,800.						Population 10,000.						Population 9,360.						Population 2,200.					
	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.
January.....	5,114,129	62.7	22.5	9.8	95.0	1,553,806	101	54	155	1,910,000	205	172,016	49.0	29.2	78.2	172,016	49.0	29.2	78.2	172,016	49.0	29.2	78.2	172,016
February.....	5,293,000	64.5	24.3	9.6	98.4	1,598,536	103	57	160	2,071,785	223	148,018	34.0	33.3	67.3	148,018	34.0	33.3	67.3	148,018	34.0	33.3	67.3	148,018
March.....	5,113,032	61.0	24.6	9.4	95.0	1,473,871	90	57	147	2,149,677	231	146,903	44.0	22.8	66.8	146,903	44.0	22.8	66.8	146,903	44.0	22.8	66.8	146,903
April.....	4,942,033	56.6	24.8	10.5	91.9	1,341,800	77	57	134	2,003,000	215	125,250	22.4	34.5	66.9	125,250	22.4	34.5	66.9	125,250	22.4	34.5	66.9	125,250
May.....	4,862,161	53.2	25.2	12.0	90.4	1,339,354	82	52	134	2,306,129	248	128,177	32.8	25.5	58.3	128,177	32.8	25.5	58.3	128,177	32.8	25.5	58.3	128,177
June.....	4,889,966	55.6	24.8	10.5	90.9	1,408,800	84	57	141	2,436,333	262	148,800	35.1	32.5	67.6	148,800	35.1	32.5	67.6	148,800	35.1	32.5	67.6	148,800
July.....	5,015,806	54.4	27.3	11.5	93.2	1,871,903	128	59	187	3,360,322	361	181,453	57.1	25.4	82.5	181,453	57.1	25.4	82.5	181,453	57.1	25.4	82.5	181,453
August.....	4,453,484	49.5	24.0	9.2	82.7	1,774,516	109	68	177	3,029,677	326	186,500	52.9	31.9	84.8	186,500	52.9	31.9	84.8	186,500	52.9	31.9	84.8	186,500
September.....	4,544,133	51.0	24.7	8.7	84.4	1,404,033	83	57	140	2,315,667	349	174,900	39.6	39.9	79.5	174,900	39.6	39.9	79.5	174,900	39.6	39.9	79.5	174,900
October.....	4,509,742	51.1	24.6	8.1	83.8	1,473,355	100	47	147	2,289,677	246	184,210	48.9	34.9	83.7	184,210	48.9	34.9	83.7	184,210	48.9	34.9	83.7	184,210
November.....	4,833,232	54.8	26.6	8.4	89.8	1,402,253	91	49	140	2,287,667	246	159,000	47.4	24.9	72.3	159,000	47.4	24.9	72.3	159,000	47.4	24.9	72.3	159,000
December.....	5,185,612	60.8	27.0	8.6	96.4	1,395,677	96	44	140	2,561,290	275	166,935	47.4	28.5	75.9	166,935	47.4	28.5	75.9	166,935	47.4	28.5	75.9	166,935
Average for the Year.....	4,596,361	56.3	25.0	9.7	91.0	1,503,115	95	55	150	2,393,435	257	160,183	42.5	30.3	72.8	160,183	42.5	30.3	72.8	160,183	42.5	30.3	72.8	160,183

Daily Record of Water Consumption in Imperial Gallons.

1917. Month.	Stettler. Population 1,200.						Claresholm. Population 1,000.						Bassano. Population 650.						Athabaska. Population 500.					
	Population 1,200.						Population 1,000.						Population 650.						Population 500.					
	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.	Daily Average for the Month.	Per Head for Domestic Purposes.	Per Head for Industrial Purposes.	Per Head for other Purposes.	Per Head for all Purposes.	Unaccounted for.
January.....	13,740	11.4	.....	.....	.....	.....	61,161	60.0	1.0	0.2	61.2	.....	164,889	13.7	124.1	115.7	253.5	.....	11,984	24.0	.....	.....	.....	.....
February.....	13,562	11.3	.....	.....	.....	.....	60,857	58.4	2.1	0.4	60.9	.....	171,071	14.9	144.0	104.2	263.1	.....	6,837	13.7	.....	.....	.....	.....
March.....	14,196	11.8	.....	.....	.....	.....	54,000	52.6	1.4	.....	54.0	.....	178,548	16.7	141.7	116.2	277.6	.....	8,629	17.3	.....	.....	.....	.....
April.....	11,294	9.4	.....	.....	.....	.....	48,000	46.7	1.3	.....	48.0	.....	193,167	16.6	166.4	114.2	297.2	.....	10,620	21.2	.....	.....	.....	.....
May.....	12,824	10.7	.....	.....	.....	.....	42,194	40.9	1.3	.....	42.2	.....	176,451	16.2	170.4	84.8	271.4	.....	14,516	29.0	.....	.....	.....	.....
June.....	12,884	10.7	.....	.....	.....	.....	40,600	38.3	1.3	.....	40.6	.....	216,187	18.7	177.7	136.2	332.6	.....	14,062	28.1	.....	.....	.....	.....
July.....	11,46	9.6	.....	.....	.....	.....	57,677	56.1	1.6	.....	57.7	.....	173,161	25.5	170.7	73.3	269.5	.....	13,608	27.2	.....	.....	.....	.....
August.....	11,193	9.3	.....	.....	.....	.....	55,161	53.5	1.7	.....	55.2	.....	182,581	21.4	167.1	92.3	280.8	.....	17,010	34.0	.....	.....	.....	.....
September.....	18,285	15.2	.....	.....	.....	.....	59,400	54.4	5.0	.....	59.4	.....	158,567	21.2	146.3	76.6	244.1	.....	14,062	28.1	.....	.....	.....	.....
October.....	19,434	16.2	.....	.....	.....	.....	76,645	74.1	2.5	.....	76.6	.....	171,774	17.4	176.3	70.5	264.2	.....	9,677	19.4	.....	.....	.....	.....
November.....	16,946	14.1	.....	.....	.....	.....	84,000	81.7	2.0	.....	84.0	.....	156,667	16.4	140.2	84.4	241.0	.....	9,375	18.8	.....	.....	.....	.....
December.....	17,745	14.8	.....	.....	.....	.....	66,967	64.5	1.9	0.6	67.0	.....	142,097	15.3	126.8	76.5	218.6	.....	13,866	26.6	.....	.....	.....	.....
Average for the year.....	14,465	12.0	.....	.....	.....	.....	58,888	56.9	1.9	0.1	58.9	.....	173,324	17.9	154.3	95.4	267.6	.....	11,974	24.0	.....	.....	.....	.....

CITIES AND TOWNS IN THE PROVINCE OF ALBERTA.

Daily Record of Water Consumption in Imperial Gallons.

1917	Carmangay.					
	Population 400.					
	Month.	Daily average for the month.	Per Head for domestic Purposes.	Per Head for industrial Purposes.	Per Head for other Pur- poses.	Per Head for all Pur- poses.	Unaccount- ed for.
January.....	11613				29 0	
February.....	11143				27 9	
March.....	11613				29 0	
April.....	12000				30 0	
May.....	11613				29 0	
June.....	12000				30 0	
July.....	12000				30 0	
August.....	12000				30 0	
September.....	14800				37 0	
October.....	15097				37 7	
November.....	13600				34 0	
December.....	12774				31 9	
Average for the year.....	12521				31 3	

RECORD OF AVERAGE DAILY WATER CONSUMPTION IN IMPERIAL GALLONS FOR YEARS 1915-1916.—1917.

Average for the Year.	Edmonton.					Regina.					Moosejaw.				
	Per Head Domestic.	Per Head Industrial.	Per Head Other Purposes.	Per Head All Purposes.	Unaccounted for.	Per Head Domestic.	Per Head Industrial.	Per Head Other Purposes.	Per Head All Purposes.	Unaccounted for.	Per Head Domestic.	Per Head Industrial.	Per Head Other Purposes.	Per Head All Purposes.	Unaccounted for.
1915.....	46.0	31.0	3.0	80.0	.....	55.0	7.5	0.1	62.6	.....	24.1	4.6	.....	28.7	.....
1916.....	52.5	20.7	5.7	73.9	.....	61.1	.....	.....	68.9	.....	35.2	12.3	.....	47.5	.....
1917.....	56.3	25.0	9.7	91.0	.....	59.2	12.6	0.3	72.1	.....	45.8	13.1	.....	58.9	.....
Lethbridge.															
1915.....	81.4	32.2	1.5	115.1	.....	17.4	.....	0.4	17.8	.....	6.6	1.3	2.7	14.8	4.2
1916.....	116.0	41.3	0.7	158.0	.....	16.9	.....	0.3	17.2	.....	9.5	2.0	4.9	22.7	6.3
1917.....	95.0	53.0	.....	150.0	.....	30.1	.....	.....	30.1	.....	10.2	2.2	4.0	23.1	6.7
Prince Albert.															
1915.....	57.0	.....	.....	57.0	.....	31.1	6.8	.....	37.9	.....	4.9	8.4	1.6	14.9	.....
1916.....	55.2	.....	.....	55.2	.....	36.8	22.1	1.0	50.9	.....	5.5	26.8	.....	32.3	.....
1917.....	84.1	.....	.....	84.1	.....	42.5	30.3	.....	72.8	.....	5.8	44.4	.....	50.2	.....
Estevan.															
1915.....	28.4	21.4	4.4	54.2	.....	14.3	.....	.....	14.3	.....	37.4	.....	8.2	45.6	.....
1916.....	24.4	17.3	2.9	44.6	.....	10.9	.....	.....	10.9	.....	43.4	.....	9.6	53.0	.....
1917.....	29.1	16.6	12.8	58.5	.....	24.0	.....	.....	24.0	.....	56.9	1.9	0.1	58.9	.....
Sutherland.															
1915.....	2.1	.....	0.4	2.5	.....	41.9	.....	2.0	43.9	.....	21.6	13.9	2.2	45.6	7.9
1916.....	2.2	.....	0.1	2.3	.....	32.6	.....	.....	32.6	.....	21.0	15.4	1.9	52.6	14.3
1917.....	1.7	.....	.....	1.7	.....	31.3	.....	.....	31.3	.....	24.4	15.6	5.8	66.4	20.6
Scott.															
1915.....	.....	.....	.....	.....	.....	181	28	15	224	.....	.....	.....	.....	.....	.....
1916.....	.....	.....	.....	.....	.....	214	.....	.....	214	.....	.....	.....	.....	.....	.....
1917.....	10.7	34.0	.....	44.7	.....	257	.....	.....	257	.....	17.3	.....	.....	17.3	.....
Humboldt.															
1915.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6.5	60.2	.....	66.7	.....
1916.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.9	154.3	95.4	267.6	.....
1917.....	21.5	.....	.....	21.5	.....	12.0	.....	.....	12.0	.....	.....	.....	.....	.....	.....

LARGE IRRIGATION PROJECTS.

The following report, prepared by Mr. Sam G. Porter, Assistant Chief Engineer, covers in a very brief way this feature of the work:—

Eastern Section, C.P.R. Irrigation Block.—"No new construction has been in progress during the year. Part of the system has been in operation and in that connection some repair and maintenance work has been done by the company. The only field inspections made were in connection with the reconstruction of the Antelope Creek siphon, and some instances of the disintegration of concrete by alkali action.

No further progress has been made in the classification of the lands which have been held pending a further study of alkali soils and drainage conditions."

Western Section, C.P.R. Irrigation Block.—"No field inspections have been made. A separate report on the examination and filing of water agreements is being submitted by Mr. Major."

The Alberta Railway & Irrigation Co.—"A field inspection of the system was made for the purpose of making a report on the condition of works. The authorized term for the completion of the construction of the works expired in October, 1917, but an extension of five years has been granted.

The system has been in operation as usual. Some work of repairs and improvements has been in progress."

The Canada Land & Irrigation Co.—"On July 1, 1917, the Southern Alberta Land Company, the Alberta Land Company, and the Canadian Wheatland Company were amalgamated under the title of the Canada Land & Irrigation Company. Some construction was undertaken late in the season and will be continued in 1918 with a view to being able to deliver water to the first unit of approximately 50,000 acres before the end of the 1918 season."

The Taber Irrigation District.—"The time allowed to the Taber Irrigation district for entering into a contract for the supply of water having expired, the district was re-erected in 1917, the boundaries of the old district being changed so as to exclude all school lands and include an additional area to the east of the original district sufficient to make up the full 17,000 acres of irrigable land for which water is available. It is hoped that an agreement between the district and the Canadian Pacific Railway will be effected in time to permit of the construction of the system during 1918."

The Lethbridge Northern Irrigation Project.—"No field work has been done during the past season on the proposed Lethbridge Northern Irrigation System. Reservation of water supply from the Oldman river has been made, based on the surveys and reports already completed."

The Milk and St. Mary Rivers Irrigation Project.—"No field work was done on this project. A small amount of office work was done completing certain plans."

Office Work.—"In addition to the correspondence and office routine work and the general supervising of the engineering work of the irrigation staff, I have examined for approval by the commissioner, the following plans besides those reported by the office engineer: Eastern Section C.P.R.: topographical maps, 19 townships, 59 plans, 2 profiles, 3 other plans. Western Section C.P.R.: 13 structure plans. Alberta Railway & Irrigation Company: 22 structure plans, 14 profiles.

Good progress has been made during the year in the preparation of the water administration records under the new system recently adopted."

DUTY OF WATER AND IRRIGATED CROP REPORTS FOR 1917.

A complete report of this work has been submitted separately, but owing to its bulk will not be published. This summary report outlines the scope of the work which was carried out and deals briefly with the more interesting features.

A record was kept of the water applied and the crops produced at the demonstration station at Strathmore. Experimental plot work on the proper duty of water was carried on at Ronalane. Data regarding the duty of water were collected at Coaldale and irrigated crop reports were submitted by the inspecting engineers for the Cypress Hills district, mainly in Saskatchewan, and for the Macleod district in Alberta.

The work was carried on under the general supervision of Mr. W. H. Snelson. Mr. J. E. Degnan collected the data in the Coaldale district and Mr. C. H. Giffen had charge of the work done at Brooks. Mr. S. Hansen of the Canada Land and Irrigation Company operated the plots at Ronalane. The Canadian Pacific Railway Company supplied the necessary labour at the Strathmore station.

DEMONSTRATION STATION, STRATHMORE, ALBERTA, 1917.

For the reasons stated in last year's report the old duty of water plots at Strathmore were operated this year as a demonstration station. It was planned to plant crops that do well in the district and then by using our best judgment in the matters of cultivation and irrigation, demonstrate what these crops would produce. Then the data gained, showing the quantities of water used, would be acceptable as indicating good farm practice.

The season of 1917 was "dry," very similar to that of 1914. The precipitation from April to September was 0.85 foot or nearly six inches less than in 1916. The outstanding features of the season were a late cold spring, great heat with very little rainfall in July, and a very late fall.

The results of the season's work were very unsatisfactory and very little useful data were gained. All the grain crops were injured by a hail storm on May 16 and on June 21 another one cut them all to the ground. One small plot of oats, sown on alfalfa land on June 4 and cut to the ground on June 21, was ripened by September 20 and yielded nearly 105 bushels per acre. The alfalfa sown in 1914 all killed out during the winter of 1916-17. The old grass plots sown in 1914 did well, but owing to scarcity of labour they could not be irrigated at the proper time and produced only small yields, varying from about 1 to 1.6 tons per acre. The potatoes, turnips and mangels all suffered from cold wet soil conditions in the spring, and produced only medium yields. The alsike clover, which was sown in 1915 and produced 5.33 bushels of seed per acre in 1916, was completely winter-killed during the following winter. It was noted, however, that a large number of shattered seed pods remained on the ground after the crop had been garnered in 1916. After the spring rains in 1917 this seed germinated, took root, and a very thick stand of alsike was obtained this season without any work other than one irrigation. This clover, cut on September 19, yielded 1.68 tons per acre.

Practically no demonstration work was carried out, or data gathered, on the farms in the vicinity of Strathmore during 1917. Owing to the widespread winter-killing of alfalfa during the past winter, practically all of the alfalfa fields, on which we had previously measured the water applied, were so thinned out as to make what information might be gathered of little value. All the grain crops in the vicinity of Strathmore were severely damaged by the hail-storm which swept the district from Keoma to Cluny June 21.

DUTY OF WATER PLOTS, RONALANE, ALTA., 1917.

The same tract of land was used for this year's work as formerly, with the exception of the alfalfa plots. The old field which had been winter-killed and had an uneven stand was abandoned for experimental purposes and a new field sown in 1916, selected for the work. The season was a dry one with the same outstanding features as described for Strathmore. The precipitation for April to September was only 0.5 foot, being nearly 10 inches less than in 1916. The following tables contain in detail the results of the 1917 work.

In the alfalfa plots the best yield of 3.13 tons per acre was produced under a total depth of water (irrigation plus precipitation) of 1.68 feet. An increase in depth produced a decrease in yield. The dry plot produced only 0.42 ton. The best wheat crop of 50 bushels was produced with a total depth of 1.86 feet. The dry plot produced only 17 bushels. The best oat crop of 106.6 bushels was produced with a total depth of 1.36 feet and an increase in depth produced a decrease in yield. The dry plot produced only 44.2 bushels. The best barley crop of 55 bushels was produced with a total depth of 1.35 feet and an increase of depth decreased the yield. The dry plot produced only 12.4 bushels. The best crop of field peas of 60.6 bushels, was produced with a total depth of 1.35 feet and an increase in depth decreased the yield. The dry plot produced only 19.5 bushels. The best crop of sugar beets of 17.2 tons, was produced with a total depth of 1.16 feet and an increase in depth decreased the yield. The dry plot produced only 9.9 tons.

Plot No.	Area.	Irrigation.										Total Depth Received.	Rainfall April 1 to Harvest.	Duty of Water.	Yield in Tons per Acre.		
		Date and Depth applied in acre-feet per acre.													1st Crop Cut July 11.	2nd Crop Cut August 25.	Total.
		May.		June.		July.		August.		Total.							
		24	4	22	29	4	17	23	28		15						
1	0.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.36	0.36	0.00	0.420	.....	0.420
2	0.25	.....	.....	0.33	.....	.....	.....	.....	.....	.....	0.36	0.69	0.33	1.316	.....	1.316
3	0.25	.....	0.33	.....	.....	.....	.....	.....	.....	.....	1.02	1.02	0.66	1.680	.....	1.680
4	0.25	.....	0.33	.....	.....	0.33	.....	.....	0.33	.....	0.36	0.36	0.99	1.35	1.400	2.668
5	0.25	0.35	.....	.....	0.33	.....	.....	.....	0.33	.....	0.36	0.36	0.99	1.35	1.400	2.548
6	0.25	0.33	.....	.....	.....	0.33	.....	.....	0.33	0.33	1.32	1.32	1.32	1.580	1.548	3.128
7	0.25	0.33	.....	0.33	.....	.....	0.33	.....	0.33	0.33	1.65	1.65	1.65	1.350	1.510	2.860
8	0.25	.....	0.50	.....	.....	.....	0.50	.....	.....	.....	1.36	1.36	1.00	1.050	0.618	1.668
9	0.25	0.50	.....	.....	0.50	.....	0.50	0.50	.....	.....	1.86	1.86	1.50	1.410	1.018	2.428
10	0.25	0.50	0.50	.....	.....	0.50	0.50	.....	0.50	.....	2.86	2.86	2.50	1.400	1.460	2.860

NOTE.—Plots were seeded 1916. Even stand. Soil—Silt loam about five feet to coarse gravel.

WHEAT (MARQUIS).

Plot No.	Area.	IRRIGATION.								Duty of Water.	Rain- Fall April 1 to Harvest	Total Depth Rec'd.	Yield in Bushels per Acre.	Remarks.
		Date and Depth applied in acre-feet per acre.												
		June.		July.				August.						
		23	29	4	10	14	24		30						14
19	0.235									0.00	0.36	0.36	17.02	Fertilized by 15 loads of manure per acre. Fall 1916. Cropped to peas 1916. Seeding rate 2 bush. per acre.
20	0.235				0.33					0.33	0.36	0.69	25.66	
21	0.235				0.33		0.33			0.66	0.36	1.02	34.34	
22	0.235			0.33	0.33			0.33		0.99	0.36	1.35	42.04	
23	0.235		0.33			0.33	0.33			0.99	0.36	1.35	39.36	
24	0.235	0.33		0.33		0.33		0.33		1.32	0.36	1.68	46.81	
25	0.235				0.50		0.50			1.00	0.36	1.36	44.30	
26	0.235		0.50			0.50		0.50		1.50	0.36	1.86	50.00	

OATS (ABUNDANCE).

Plot No.	Area.	IRRIGATION — Date and Depth applied in acre-feet per acre.								Duty of Water.	Rainfall April 1 to Harvest.	Total Depth Rec'd.	Yield in Bushels per Acre.	Remarks.
		June.		July.										
		23	29	4	10	14	24	30						
48	0.28	0.00	0.36	0.36	44.18	Oat plots were cropped to potatoes in 1916. Fertilized 15 loads manure per acre fall 1916. Seeded at a rate of 3 bushels per acre.	
43	0.235	.....	.....	.....	0.33	.....	.....	.....	0.33	0.36	0.69	59.57
44	0.235	.....	.....	.....	0.33	.....	0.33	.....	0.66	0.36	1.02	63.23
45	0.235	.....	.....	0.33	.....	0.33	.....	0.33	0.99	0.36	1.35	84.47
46	0.235	.....	0.33	.....	.....	0.33	0.33	.....	0.99	0.36	1.35	95.74
47	0.31	0.33	.....	0.33	.....	0.33	.....	0.33	1.32	0.36	1.68	100.58
49	0.24	0.50	0.50	1.00	0.36	1.36	106.62		
50	0.41	.....	.....	.....	0.75	.....	0.50	.....	1.25	0.36	1.61	76.39

BARLEY (CALIFORNIA FEED).

Plot No.	Area.	IRRIGATION.							Duty of Water.	Rainfall April 1 to Harvest.	Total Depth received.	Yield in Bushels per acre.	Remarks.
		Date and Depth applied in acre-feet per acre.											
		June.		July.									
		23	29	4	10	14	24	30					
27	0.235	.....	.....	.....	.....	.....	.....	.....	0.36	0.36	12.42	Barley plots were cropped to oats in 1916. Fertilized with 15 loads of manure per acre in fall of 1916. Seeded at rate of 2½ bush. per acre.	
28	0.235	.....	.....	0.33	.....	.....	.....	0.33	0.36	0.69	27.02		
29	0.235	.....	.....	0.33	.....	.....	.....	0.33	0.66	0.36	1.02		38.13
30	0.235	.....	.....	0.33	.....	.....	0.33	.....	0.66	0.36	1.02		49.62
31	0.235	0.33	.....	.....	.....	0.33	.....	0.33	0.99	0.36	1.35		54.98
32	0.235	0.33	.....	0.33	.....	0.33	.....	0.33	1.32	0.36	1.68		51.87
33	0.235	.....	.....	.....	0.50	.....	0.50	.....	1.00	0.36	1.36	42.55	
34	0.235	.....	.....	0.50	.....	0.50	.....	0.50	1.50	0.36	1.86	44.76	

PEAS (PRUSSIAN BLUE).

Plot No.	Area.	IRRIGATION.									Duty of Water.	Rainfall April 1 to Harvest.	Total Depth received.	Yield in Bushels per acre.	Remarks.
		Date and Depth applied in acre-feet per acre.													
		May.		June.		July.				Aug.					
		.....	23	29	4	10	14	24	30	14				
11....	0.235	0.00	0.36	0.36	19.49	Fertilized by 15 loads manure per acre, fall 1916. Cropped to oats 1916. Seed inoculated by culture. Seeding rate 3 bushels per acre.	
12....	0.235	.....	.....	.....	0.33	.....	.....	.....	.....	0.33	0.36	0.69	24.47
13....	0.235	.....	.....	.....	.....	0.33	.....	0.33	.....	0.66	0.36	1.02	49.62
14....	0.235	.....	.....	.....	0.33	0.33	.....	.....	0.33	0.99	0.36	1.35	60.25
15....	0.235	.....	.....	0.33	.....	0.33	.....	.....	0.33	0.99	0.36	1.35	60.64
16....	0.235	.....	0.33	.....	0.33	.....	0.33	.....	0.33	1.65	0.36	2.01	58.13
17....	0.235	.....	.....	.....	.....	0.50	.....	0.50	.....	1.00	0.36	1.36	33.66
18....	0.235	0.50	0.50	0.50	1.50	0.36	1.86	52.13		

SUGAR BEETS (VILMORINS).

Plot No.	Area.	IRRIGATION.						Duty of Water.	Rainfall April 1 to Harvest.	Total Depth Rec'd.	Yield in Tons per acre.	Remarks.
		Date and Depth applied in acre-feet per acre.										
		July.				August.						
		11	14	24	30	14	24					
51	0.11	0.00	0.50	0.50	9.91	All sugar beet plots were cropped to potatoes in 1916, and fertilized with twenty loads of manure per acre. Spring, 1917.
52	0.11	.....	.....	0.33	.....	.....	0.33	0.66	0.50	1.16	17.18
53	0.25	.....	0.33	.....	0.33	.....	0.33	0.99	0.50	1.49	15.04
54	0.28	0.33	.....	0.33	.....	0.33	0.33	1.32	0.50	1.82	16.07

DUTY OF WATER, COALDALE, ALTA., 1917.

The work at Coaldale was carried on during 1917 in the same manner as previously. The season was a very dry one and from April to September the precipitation was hardly two inches greater than in 1914 and nearly ten inches less than last year. The results gained are somewhat unsatisfactory because conditions were not normal. Experienced irrigators were scarce and wages high and as a consequence many of the farmers delayed their irrigation until it was too late to get the best results. In many instances the farmers applied only one irrigation and this an excessively heavy one. When these excessive irrigations are applied, a large percentage of the water probably percolates too deep to be of much immediate value to the growing crop. Much better yields would have resulted had the same amount of water been applied in two or three smaller irrigations. Plot No. 313, receiving two irrigations of moderate depth at the proper times, is an excellent example of this. This plot produced 4.13 tons of alfalfa as compared with about 2.5 tons on the other plots receiving only one irrigation.

Very careful data were gathered, showing the change in the quantity of available water held in the soil at the beginning and at the end of the season. These data, however, covering a depth of six feet of soil, are particularly liable to error this year, in being utilized to show the total amount of water used in growing the crop, because, owing to the generally excessively heavy irrigations, it is probable that considerable portions of the water applied were lost by deep percolation. These data are therefore not shown in the summarized table, which follows, giving the results of the 1917 work.

DUTY OF WATER TRACTS, COALDALE, ALTA., 1917.

Crop.	Plot No.	Acres.	No.	IRRIGATION.				ACRE-FEET PER ACRE.						YIELD.		
				Began.	Ended.	Dur- ation in Hours	Aver- age Head C.F.S.	Sup- plied.	Wasted.	Used.	Used per Acre.	Duty.	*Rain- fall.	Total Water Receiv- ing.	Per Cutting.	Per Acre.
Alfalfa.....	304	42.0	1	Aug. 22	Sept. 5	342	1.16	33.00	0.00	33.00	0.79	0.79	0.70	1.49	Tons. 1.96	2.46
"	306	14.0	1	July 26	Aug. 1	152	2.35	26.72	3.07	23.65	1.68	1.68	0.70	2.38	0.50	2.46
"	312	50.0	1	July 19	Aug. 5	428	2.54	89.58	0.00	89.58	1.79	1.79	0.66	2.45	1.54	2.65
"	313	50.0	1	June 22	July 7	315	1.21	37.59	5.95	31.64	0.63	0.63	0.66	1.69	1.11	2.24
"	315	50.0	2	Aug. 10	Aug. 14	95	2.56	20.06	0.00	20.06	0.40	1.03	0.66	2.60	1.02	2.24
"	315	50.0	1	July 17	Aug. 6	476	1.24	51.69	0.00	51.69	1.03	1.03	0.66	1.69	1.53	4.13
Alfalfa and Timothy.....	305	23.5	1	Aug. 2	Aug. 10	200	2.24	37.80	1.13	36.67	1.56	1.56	0.70	2.26	1.37	2.38
Timothy	307	78.0	1	June 27	July 8	251	4.30	89.82	15.00	74.82	0.96	0.96	0.70	2.25	1.01	3.53
Timothy	303	22.5	1	June 27	July 5	190	2.86	44.88	0.00	44.88	1.99	1.99	0.72	1.66	1.28	1.17
Wheat	323	8.5	1	July 13	July 17	90	0.75	5.62	0.00	5.62	0.66	0.66	0.41	2.71	1.17	1.33
Wheat	322	13.3	1	July 16	July 8	58	2.45	11.78	0.00	11.78	0.89	0.89	0.41	1.07	1.33	23.5
Summer-fallow	309	26.0	1	Sept. 19	Sept. 27	63	4.48	23.22	0.00	23.22	0.90	0.90	0.72	1.30	1.01	32.3
"	308	50.0	1	Sept. 10	Sept. 19	121	4.48	44.74	0.00	44.74	0.90	0.90	0.72	1.62	2.25	32.3
Average for the 12 irrigated tracks.....															1.18	1.83
* Rainfall between seeding and Harvest.....															0.65	

No data is shown for plots 311, 317, 318, 310, 314, 302, 316. The first four were not irrigated or only partially irrigated on account of lack of water supply. The last three were either flooded with waste water from adjoining fields or pastured so that in neither case is accurate data available.

TABLE NO. 7, SHOWING TOTAL DEPTH OF WATER USED ON COALDALE, ALTA., TRACTS FROM 1913 TO 1917.

Crop.	1913.			1914.			1915.			1916.			1917.			Average for the period 1913-1917.		
	Duty.	Precipitation.	Total Water Received.	Duty.	Precipitation.	Total Water Received.	Duty.	Precipitation.	Total Water Received.	Duty.	Precipitation.	Total Water Received.	Duty.	Precipitation.	Total Water Received.	Duty.	Precipitation.	Total Water Received.
Alfalfa	1.70	0.98	2.68	2.11	0.57	2.68	0.68	1.32	2.00	0.41	1.56	1.97	1.31	0.72	2.03	1.24	1.03	2.27
Timothy.....	0.85	0.98	1.83	.....	.....	.....	1.28	1.32	2.60	0.33	1.56	1.89	1.48	0.72	2.20	0.99	1.14	2.13
Wheat.....	0.74	0.98	1.72	.....	.....	.....	0.22	1.32	1.54	0.17	1.56	1.73	0.78	0.72	1.50	0.48	1.14	1.62
Oats .....	.....	.....	.....	1.49	0.57	2.06	0.00	1.32	1.32	0.25	1.56	1.81	.....	.....	.....	0.58	1.15	1.73
Barley.....	.....	.....	.....	1.25	0.57	1.82	0.00	1.32	1.32	0.00	1.56	1.56	.....	.....	.....	0.42	1.15	1.57
Average for all crops.....	1.15	0.98	2.13	1.84	0.57	2.41	0.57	1.32	1.89	0.28	1.56	1.84	1.24	0.72	1.96	1.01	.....	2.05

1913. No oat or barley tracts available.

1914. No timothy grown on tracts. Wheat tracts were dried up and destroyed by cutworms.

1917. No barley grown on tracts. Oat tracts were at extreme end of canal system which at the critical time did not contain sufficient water to permit of them being irrigated.

The above table shows the average total depth of water received (irrigation plus precipitation) for the Coaldale plots for 1913 to 1917. The average total depth of water received by the grain plots for five years is 1.66 feet, the average duty of water for the same five years is 0.63 foot. For the alfalfa and grasses the average total depth received for five years is 2.24 feet, the average duty of water is 1.21 feet. For all the plots, grasses, alfalfa and grains, the average total depth received for five years is 2.05 feet. The average duty of water for five years is 1.01 feet.

BROOKS EXPERIMENT STATION.

No data were gained this season at this station, which is situated within a mile or two of Brooks. In the spring the station, comprising forty acres, was taken over as virgin prairie land and the season was devoted to putting the land in shape for work next year. The plots were carefully surveyed, fences built, buildings erected, supply ditch constructed, well dug, and the land was broken, worked up, back-set and levelled.

The Canadian Pacific Railway Company operate a demonstration farm at Brooks and some general information was gathered concerning the quantity of water used there. A total of 124.9 acres were irrigated, of which area about 88 per cent was sown to alfalfa, clovers, grasses and garden, and about 12 per cent to grains and cultivated crops. The general duty of water was 1.95 feet, the precipitation from April to September 0.57 foot, making the total depth of water, received by the crops, 2.52 feet. Fifty-two per cent of the irrigation water was supplied in June, 31 per cent in July and 17 per cent in August. The soil on this farm is generally fine sand overlying coarser sand, and of such a character as would be expected to use a large quantity of water.

DISCUSSION OF SUMMARIZED DATA.

The natural precipitation varies greatly from year to year and directly affects the duty of water. In dry years a greater depth of irrigation is required than in wet years. The clearest way to view the matter is to consider both natural precipitation and irrigation water simply as so much depth of water applied to the crops. Then by

adding together natural precipitation and irrigation we get the total depth of water applied and thus have a figure which is readily comparable from year to year. This latter statement must not be accepted absolutely, because the seasonal distribution of the precipitation and temperature also has a marked effect on the crop growth. It must also be always kept in mind that soil and subsoil conditions have a very marked effect on the duty of water, so that in comparing results gained at different places many conditions must be considered to get a true perspective.

The first table below is inserted to show the climatic conditions for the four years 1914, 1915, 1916 and 1917, at the three stations from which data have been taken in writing the general discussion on duty of water for several crops which follows. The second table is inserted for purposes of comparison showing the average climatic conditions which prevailed during the four years as compared with long term averages. In both cases the period April to September, both inclusive is used.

	Precipitation.				Temperature.			
	1914.	1915.	1916.	1917.	1914.	1915.	1916.	1917.
	Feet.	Feet.	Feet.	Feet.	°F.	°F.	°F.	°F.
Strathmore.....	0.71	1.44	1.33	0.85	52.4	52.6	50.6	52.0
Ronalane.....	0.38	0.93	1.32	0.50	59.4	57.1	55.2	55.8
Coaldale.....	0.57	1.32	1.56	0.72	55.9	55.4	54.5	55.4
Brooks.....	.....	.....	.....	0.57	55.6	56.3	.....	56.3

	Precipitation.		Temperature.	
	1914-1917.	Long Term.	1914-1917.	Long Term.
	Feet.	Feet.	°F.	°F.
Calgary.....	0.86	1.05	53.89	52.31
Medicine Hat.....	0.84	0.78	59.69	58.73
Lethbridge.....	1.04	0.97	54.57	55.69

Calgary—index for Strathmore—long term records 1885-1917.

Medicine Hat—index for Ronalane and Brooks—long term records 1884-1917.

Lethbridge—index for Coaldale—long term records 1903-1917.

In considering the final discussion hereunder it must be borne in mind that the proper depths of water indicated are only tentative. The desire is to indicate as truly as possible the proper depths based on the incomplete data now available. Even with this understanding it is extremely difficult to discuss any feature definitely because one has to deal with a maze of figures and many special conditions arising in the practical work, all of which will affect the cataloguing of true conclusions unless the greatest caution is exercised.

In preparing the discussion below the writer has used the greatest license, after a careful study, in adopting the data which in his opinion first show a true comparison and secondly stand the test of practical and economical usage.

In all cases in discussion hereunder the natural precipitation quoted is for the period April 1 to September 30.

Wheat.

The tentative statement was made last year that a total depth of 1.5 feet is sufficient for wheat. No data were gained this year which would tend to disprove this as a general statement. Total depths of 1.68 feet and 1.86 feet, produced respectively the two best yields of 47 bushels and 50 bushels at Ronalane during 1917. The difference between 1.5 feet and 1.86 feet is easily accounted for by the very porous gravel subsoil at Ronalane.

OATS.

At the Strathmore plots, during 1916, 1.30 feet produced the best yield of 133 bushels.

At Coaldale, during 1914, the natural precipitation of 0.57 foot produced a crop failure; during 1915, the natural precipitation of 1.32 feet produced bumper crops; during 1916, the natural precipitation of 1.56 feet produced better results than a depth of 2.06 feet.

At Ronalane, during 1915, the smallest irrigation given was 0.26 foot, making a total depth of 1.45 feet, which produced 76 bushels. As the irrigation was increased there was a constant increase in yield up to the greatest total depth of 3 feet, which produced 108 bushels. During 1916, a depth of 1.82 feet produced the best crop of 79 bushels. The total depths of 1.36 feet and 1.68 feet produced, respectively, the two best yields of 106 bushels and 100 bushels during 1917.

It would appear safe at this time to suggest that a total depth of 1.5 feet is also sufficient for oats.

BARLEY.

At the Strathmore plots, during 1915, the crop was spoiled by hail; during 1916, the natural precipitation of 1.33 feet produced an average of 46.3 bushels on eight plots which had not been manured, while the average for two manured plots increased to 86 bushels.

At Ronalane plots, during 1915, the natural precipitation, 0.93 foot, produced 60 bushels on summer-fallow, and additional depths decreased the yield; during 1916, 1.32 feet produced 52.5 bushels, 1.77 feet produced 55.6 bushels, while additional depths decreased the yield; during 1917, 1.35 feet produced 55 bushels, while additional depths decreased the yield.

These data indicate that barley requires rather less water than wheat or oats and that a total depth of 1.5 feet is sufficient.

FIELD PEAS.

At the Strathmore plots, during 1914, the greatest depth applied was 1.11 feet, which showed a marked increase over the dry crop, producing 40 bushels; during 1915, the plots were badly hailed, making comparison impossible; during 1916, the plots were damaged by strong winds drifting the soil, and owing to a backward spring and a wet month of August, neither the irrigated nor the non-irrigated plots were fully matured.

At the Ronalane plots, during 1915, the natural precipitation of 0.93 foot produced 23.3 bushels and irrigation produced no increase; during 1916, 1.32 feet produced a good crop of 41 bushels, and 2.90 feet produced 53 bushels, but intermediate depths of 1.82 feet and 2.32 feet did not show corresponding results, so that comparison is made unreliable; during 1917, 1.35 feet produced 60 bushels, while additional depths decreased the yield.

POTATOES.

At the Strathmore plots during 1914 the greatest depth applied was 1.11 feet, which showed a marked increase in yield over the dry crop, producing 353 bushels; during 1915 the potato crop was diseased, which made comparative results unreliable; during 1916 the natural precipitation of 1.33 feet produced a fine yield of 542 bushels.

At Ronalane plots, during 1914, the plots were all very heavily irrigated and all the yields were very small, indicating that all the plots were over-irrigated; during 1915 the best results were obtained by using 1.53 feet, producing 393 bushels; during 1916 the best results were gained by using 1.82 feet; five plots received this amount and the average yield was 284 bushels. No new data were gained during 1917.

Sugar Beets.

At the Strathmore plots during 1915, the stand obtained was poor and uneven, but the results indicate the natural precipitation of 1.44 feet produced as well as any irrigated plot; during 1916 the beets were in low wet ground and again produced a very poor crop.

At the Ronalane plots, during 1915, the best crop was produced by 1.55 feet, yielding 16 tons; during 1916 the plots are not properly comparable, but the results indicate that a depth of 2.24 feet was ample, if not too much; during 1917 1.16 feet produced 17 tons, while additional depths up to 1.82 feet decreased the yield slightly.

Alfalfa.

The tentative statement was made last year that a total depth of 2.5 feet is sufficient for alfalfa and the data gained this year tends to confirm this.

During 1917 at Coaldale the average total depth used was 2.03 feet. This makes the average for all fields observed from 1913 to 1917, 2.27 feet. The plots number 302 and 304 which have been referred to in previous years, were improperly irrigated during 1917, due mainly to shortage of help. This field produced 4.13 tons with a total depth of 1.75 feet.

At Ronalane during 1917 the two best yields of 3.1 tons and 2.9 tons were produced by 1.68 feet and 2.01 feet respectively.

Grasses.

Very little additional data are available over that published last year. The most reliable index available seems to be the average for the period 1913 to 1917 at Coaldale. This shows that timothy hay received 2.13 feet as compared with 2.27 feet for alfalfa during the same period.

CROP REPORTS.

The crop reports submitted by the several inspecting engineers do not contain very much that is new since last year. The following table is published with a view to making a clearer distinction in the Cypress Hills district between lands which are actually being irrigated and those which are irrigable but not being irrigated.

Classification.	North.	South.	East.	West.	Total Acres.
AREA IRRIGATED.					
Cultivated land—					
Alfalfa.....	188			38	
Timothy.....	55	130	251	48	
Bromus.....	10	3	35	11	
Mixed grasses.....				30	
Western rye.....				16	
Sweet clover.....				2	
Green feed.....	230				
Grains.....	150	303	56	623	
Potatoes.....				5	
	633	436	342	773	2,184
Land not cultivated—					
Wild hay.....	5,461	212	3,897	2,910	
Grazed.....	1,333	725	637	2,362	
	6,794	937	4,534	5,272	17,537
AREA IRRIGABLE BUT NOT IRRIGATED.					
Cultivated land—					
Alfalfa.....	21	20	38	16	
Timothy.....	16	108	5	1	
Bromus.....	6		136	20	
Western rye.....				10	
Green feed.....	85	224		90	
Grains.....	1,260	1,416	1,142	346	
Fallow land.....				80	
	1,388	1,768	1,321	563	5,040
Land not cultivated—					
Wild hay.....	260	861	390	41	
Grazed.....	9,694	9,680	9,053	8,442	
	9,954	10,541	9,443	8,483	38,421
Totals.....	18,769	13,682	15,640	15,091	63,182

NOTE.—In the west district there are 1,327 acres of land not irrigated, which are not reported on. Total acres irrigated 19,721. Total acres not irrigated 43,461.

North Cypress Hills District.

Mr. J. S. Tempest reports as follows:—

From the above figures it may be seen that approximately 40 per cent of the irrigable area of the North Cypress Hills district was irrigated during the season of 1917. Of this irrigated land only 8 per cent had been cultivated, while 91·5 per cent was wild land.

It is a difficult matter to make fair deductions as regards crop yields from the comparison of irrigated with unirrigated lands, other conditions are so varied, but as far as can be ascertained, from the reports of owners, the average yield of alfalfa under irrigation was 2·6 tons per acre against two tons per acre raised on unirrigated land. In arriving at the latter average no cognizance was taken of those areas where, through the long continued drought, the alfalfa was scorched and gave no yield. To my knowledge there were such cases, but I have no record of them. It is probable that some of those unirrigated lands that yielded an average of two tons were specially favoured as regards seepage water or the proximity to the surface of ground water.

By far, the greater part of the irrigated land was devoted to the growth of wild hay averaging 1·03 tons per acre against 0·54 ton of wild hay from the

land not irrigated. Included in the latter average was some hay that was cut after two years' growth.

As intimated in my general report, irrigation is not carried out in the district, excepting in a very few cases. One great obstacle to more efficient farming and irrigation is that commonly the farmers and ranchers have more land than they can handle and intensive agriculture does not appeal to a man who can make a good or fairly good living by following the easier, haphazard methods of the old time rancher. The necessity, however, of methods that will augment production of feed is beginning to be felt more and more every year. The more alert business men amongst the ranchers, recognizing this necessity, are taking a keener interest in irrigation, not as in former years with a view to getting title to more land, but with a view to getting larger crops for the maintenance of their herds through the winter.

Owners of irrigation schemes are being encouraged and should be further encouraged to plough up and cultivate more of the land now growing wild hay and devoting it to the production of the more profitable tame grasses and alfalfa. In doing this more attention should be paid to the preparation of the seed bed, evening the land and laying it out on some system so that the water can be easily and efficiently applied.

West Cypress Hills District.

Mr. J. C. Milligan reports as follows:—

From the above figures approximately 37 per cent of the irrigable area in West Cypress Hills district was irrigated during the season of 1917. Of the irrigated land only 14.3 per cent has been cultivated, 85.7 per cent still being virgin prairie.

No fair deduction can be made with respect to the comparisons of yield except perhaps in regard to the growing of blue joint hay. With irrigation this hay yielded as high as three tons to the acre in places, but this yield was not regular over the whole of any meadow, as efficient irrigation was not practised. Practically no hay was cut where irrigation was not used except on the high ridge land of the Cypress hills; grass was short and I have no doubt that there was a great scarcity of feed during the winter.

Irrigation was confined to a few schemes and even on these schemes irrigation was only practised in a desultory manner."

EVAPORATION FROM A FREE WATER SURFACE.

These data were collected in the same manner as described in the 1915 report.

COALDALE, ALTA.

Month.	Total evaporation in inches.			Average 3 years.
	1915	1916	1917	
April.....	5.68	1.51	2.55	3.25
May.....	4.28	5.12	4.83	4.74
June.....	2.26	4.68	5.78	4.24
July.....	4.38	6.20	9.20	6.59
August.....	4.97	4.70	5.23	4.97
September.....	2.93	3.59	4.35	3.62
Total.....	24.50	25.80	31.94	27.41

STRATHMORE, ALTA.

Month.	Total evaporation in inches.			Average 3 years.
	1915	1916	1917	
April.....	4.22	2.59	2.09	2.97
May.....	4.73	3.46	3.70	3.96
June.....	4.33	4.59	4.60	4.51
July.....	6.47	4.84	5.88	5.73
August.....	4.25	3.16	3.66	3.69
September.....	2.27	2.66	2.27	2.40
Total.....	26.27	21.30	22.20	23.26

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